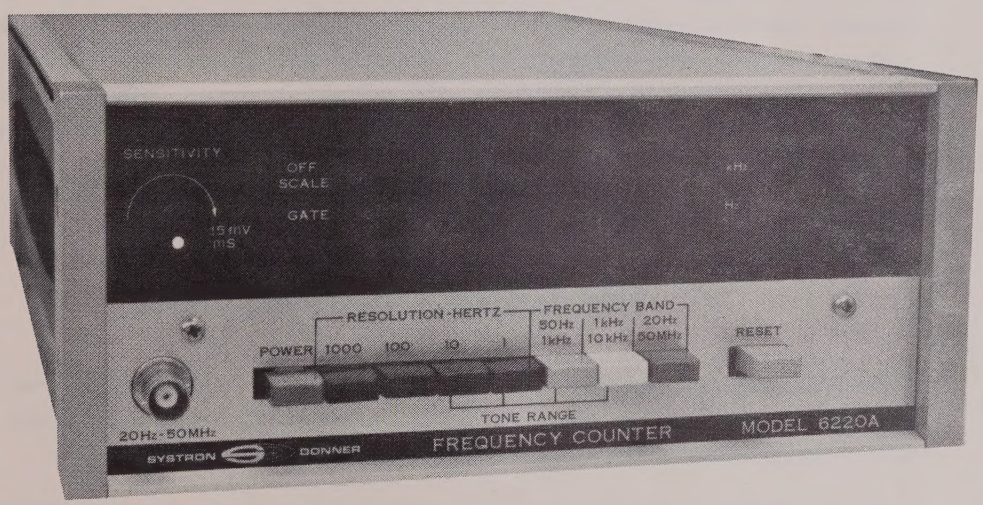
MODEL 6220A
FREQUENCY COUNTER
SERIAL NO.
Data P (A)

SYSTRON DONNER

INSTRUCTION MANUAL



MODEL 6220A
FREQUENCY COUNTER
SERIAL NO.
Dots P Ⓐ

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SYSTRON DONNER CORPORATION

CONCORD INSTRUMENT DIVISION
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Richard F. Hall
General Manager

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Company _____ Department _____

Name _____ Title _____

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- ☐ Excellent
- ☐ Fair
- ☐ Poor

DELIVERY
- ☐ Early
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- ☐ As Expected
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ADDENDUM

MODEL 6220A

Make the following changes listed below;

Page 6-7 A1, LOGIC SCHEMATIC #7-05365201 REV A

IS

102614, C7, Capacitor, EL AX, 250 µF, +100-10%, 25V

WAS

10258, C7 Capicator, EL AX 200 µF, 25V

Page 7-5 Replaceable Parts List, A1, Logic Assembly #05315801
Make the change listed above.

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CHAPTER 1
GENERAL INFORMATION

1.1 INTRODUCTION

The Model 6220A Frequency Counter is a 50 MHz Counter which features the Systron-Donner half rack design and a highly readable seven-segment display. An eight-digit readout is standard and includes a leading zero suppression feature for error free readings. Options include operation by an internal, rechargeable battery or by an external dc voltage source. A unique phase lock/frequency multiplier technique permits high resolution and high speed direct reading of low frequency signals.

Light weight, portability, and highly accurate direct readings combine to make this instrument a valuable addition for laboratory or field use.

1.2 SPECIFICATIONS

TABLE 1.1 SPECIFICATIONS

FREQUENCY MEASUREMENT	
DIRECT	
Range:	20 Hz to 50 MHz
Resolution:	1 Hz to 1 kHz selectable in decade steps
Display:	kHz with autopositioned decimal point
Accuracy:	±1 count ±time base accuracy
X 100 MULTIPLIER	
Range:	1 kHz to 10 kHz
Resolution:	0.01 Hz or 0.1 Hz
Display:	Hz with autopositioned decimal point
Accuracy:	±2 counts ±time base accuracy
X 1000 MULTIPLIER	
Range:	50 Hz to 1 kHz
Resolution:	0.001 Hz or 0.01 Hz
Display:	Hz with autopositioned decimal point

TABLE 1.1 SPECIFICATIONS (Cont'd)

X 1000 MULTIPLIER (Cont'd)	
Accuracy:	±2 counts ±time base accuracy
STANDARD TIME BASE	
Aging Rate:	<±3 parts in 10^7/month
Temperature Stability:	<±5 parts in 10^6 from 0°C to 50°C <±2 parts in 10^6 from 20°C to 40°C, typical
Line Voltage:	<±1 part in 10^7 for 10% line variation
External Input:	1 MHz at 1 volt rms into 1 kΩ
GENERAL	
Readout:	Eight digits plus off-scale indicator for register over-flow. kHz and Hz indicator.
Display Storage:	Holds reading between samples
Sensitivity: (Direct and Multiplier Input)	25 mV rms with variable attenuator
Impedance:	One megohm and 25 pF
Power:	100-115 or 200-230 V ac ±10% 48-440 Hz, 17 W
Dimensions:	8.75 X 20.9 X 33.75 cm (3 1/2" H X 8 3/8" W X 13 1/2" D)
Weight:	4.5 kg (10 lbs) net: 7.7 kg (17 lbs) shipping.

1.3 OPTIONS

The Options listed in Table 1.2 are standard options available on the instrument.

TABLE 1.2 STANDARD OPTIONS

Option	Description
06	Internally mounted Battery Pack with built-in recharging circuit. Approximate three hour operating cycle.

TABLE 1.2 STANDARD OPTIONS (Cont'd)

Option	Description
07	DC Operation - Permits operation from an external dc power source.
08	Time Base Oscillator - Improves time base temperature stability to ±1 part in 10^6 from 0 to 50°C.
09	Time Base Oscillator - Improves time base temperature stability to ±1 part in 10^7 from 0 to 50°C.
*11	Time Base Oscillator - Aging Rate ±3 parts in 10^9 per day. Temperature Stability ±1 part in 10^8, 0 to 50°C.
*12	Time Base Oscillator - Aging Rate ±1 part in 10^9 per day. Temperature Stability ±1 part in 10^8, 0 to 50°C.
*13	Time Base Oscillator - Aging Rate ±5 parts in 10^{10} per day. Temperature Stability ±1 part in 10^8, 0 to 50°C.
	* Not available when Option 06 or Option 07 installed.
Rack Mounting	Provides for rack mounting the instrument in either half rack or dual mount installation.

1.4 LOGIC SYMBOLS AND NOTATIONS

Since most of the integrated circuit modules used in this instrument are DTL/TTL compatible, most signal levels are 0.0 V to 0.8 V LOW (L) and +2.4 V to 5.0 V HIGH (H) (See Figure 1.1). Symbols used conform to MIL STD 806B.

The active state of a logic line is identified with the absence or inclusion of bar notation over the signal name. For example: RESET; indicates a high-level condition producing the active state of reset. $\overline{\text{RESET}}$; indicates a low-level condition producing the active state of reset. In general, an open line to a logic symbol is considered a HIGH.

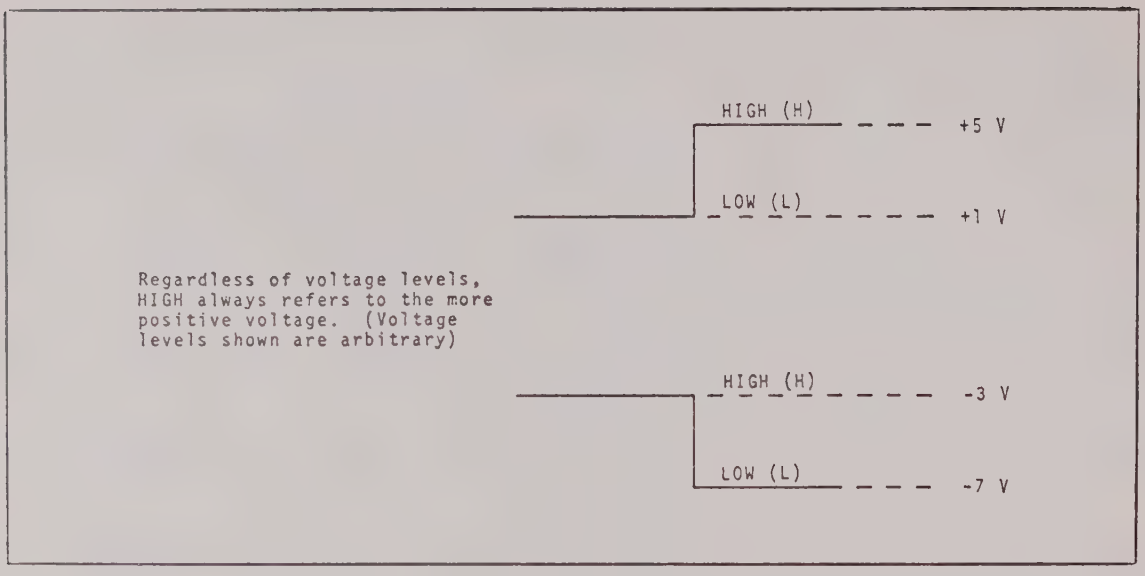

FIGURE 1.1 DEFINITION OF LOGIC LEVELS

CHAPTER 2
INSTALLATION

2.1 INTRODUCTION

The S-D Model 6220A Frequency Counter is shipped in an operational condition and is essentially ready for use as received. This chapter outlines the procedures for initial inspection and installation of the instrument. Instructions for reshipment are also included should the unit be returned to Systron-Donner Corporation for service or repair.

2.2 RECEIVING INSPECTION

Prior to accepting the counter from the shipper, inspect the condition of the shipping container for any indication of freight damage. Any sign of such damage must be noted by both the shipper and receiver and should be reported to the insurance investigator.

Immediately following removal of the instrument from the shipping carton, inspect for possible physical damage incurred during shipment. Check surfaces for scratches or dents and note condition of controls and connectors. Should any damage be noted, notify your nearest Systron-Donner representative---DO NOT USE THE COUNTER UNTIL INSTRUCTED TO DO SO BY THE REPRESENTATIVE.

2.3 RESHIPMENT

When the instrument is to be repackaged for shipment use the original packing materials. Your Systron-Donner field office can provide materials similar to those used for the original factory packaging, or repackage the instrument following these general instructions:

GENERAL PACKING INSTRUCTIONS

1) Attach a tag to the unit indicating the model number, serial number, name and address of the instrument owner, and a summary of the service or repairs required.
2) Wrap the instrument in heavy paper or plastic prior to placing it into the shipping container.
3) Select a strong carton or wooden box to house the instrument.
4) Use an adequate layer of shock-absorbing material on all sides of the instrument and protect the front panel with additional layers of cardboard. Be certain that there is no movement of the unit within the container.
5) Seal the package with strong tape or metal bands.
6) Mark the shipping container "FRAGILE - DELICATE INSTRUMENT" to ensure careful handling.

7) Be certain that all correspondence refers to full instrument nomenclature, model, and serial number.

2.4 POWER REQUIREMENTS

The Model 6220A Frequency Counter is supplied with a standard three-conductor power cord which, when plugged into an appropriate power receptacle, grounds the chassis to protect operating personnel from certain electrical hazards. Whenever the power cord is mated to a two-conductor outlet, a cord adapter plug (properly installed) will provide the same protection.

The instrument operates from either 100, 115, 200, or 230 V at 48 to 440 Hz and consumes approximately 17 W of power. Taps on the primary of the power transformer are provided to accommodate these power line requirements. Drawing #053647 and #05315801 show the placement of the jumpers for the various line voltage levels.

Check to assure the proper fuse is installed prior to applying power to the instrument. An 0.5 ampere fuse is required for 100-115 V operation and 0.25 ampere fuse for 200-230 V operation.

CHAPTER 3
OPERATION

3.1 INTRODUCTION

This operational description of the Model 6220A Frequency Counter includes a functional description of the front and rear panel controls, connectors, and indicators, along with a step-by-step operating procedure.

3.2 FRONT PANEL FUNCTIONS

The following table describes the controls, connectors, and indicators on the front panel of the instrument. Location is shown in Figure 3.1.

TABLE 3.1 FRONT PANEL FUNCTIONS

Index	Name	Function
1	POWER	This push-on push-off switch applies power to the instrument in either ac or battery operation. It also charges the battery when Option 06 is installed.
2	RESOLUTION HERTZ	This interlocked set of four push-button switches selects the desired resolution.
	1000*	When depressed, this pushbutton switch selects 1 kHz resolution when the 20 Hz-50 MHz is selected. Ineffective in the TONE RANGE.
	100*	When depressed, this pushbutton switch selects 100 Hz resolution when the 20 Hz-50 MHz frequency is selected. Ineffective in the TONE RANGE.
	10	When depressed, this pushbutton switch selects 10 Hz resolution when the 20 Hz-50 MHz is selected. Selects 0.01 Hz resolution when the 50 Hz-1 KHz TONE RANGE is selected and 0.1 Hz resolution when the 1 KHz-10 KHz TONE RANGE is selected.
	1	When depressed, this pushbutton switch selects 1 Hz resolution when the 20 Hz-50 MHz frequency is selected. Selects 0.001 Hz resolution when

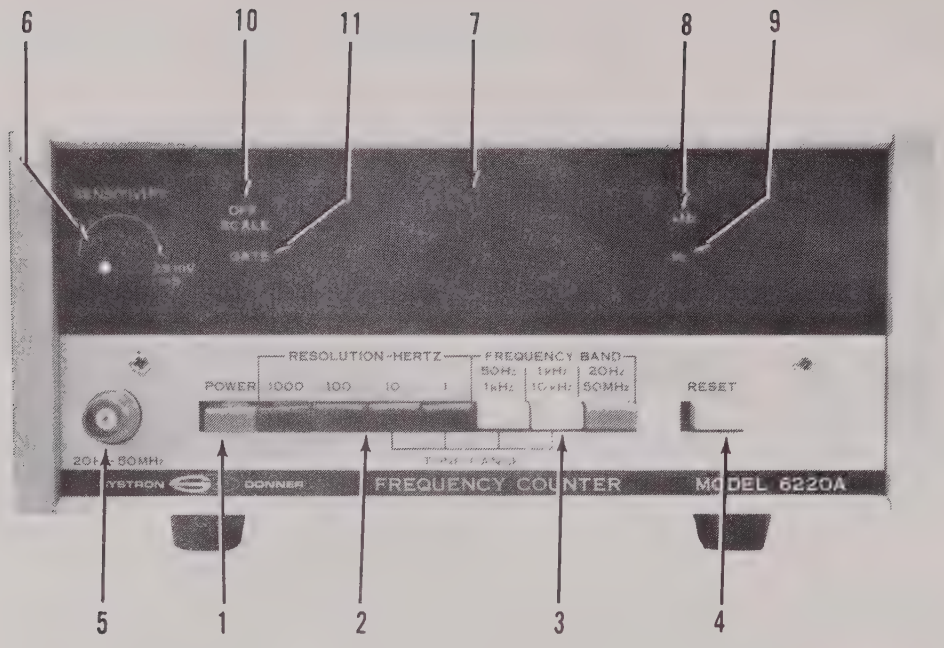

FIGURE 3.1 FRONT PANEL

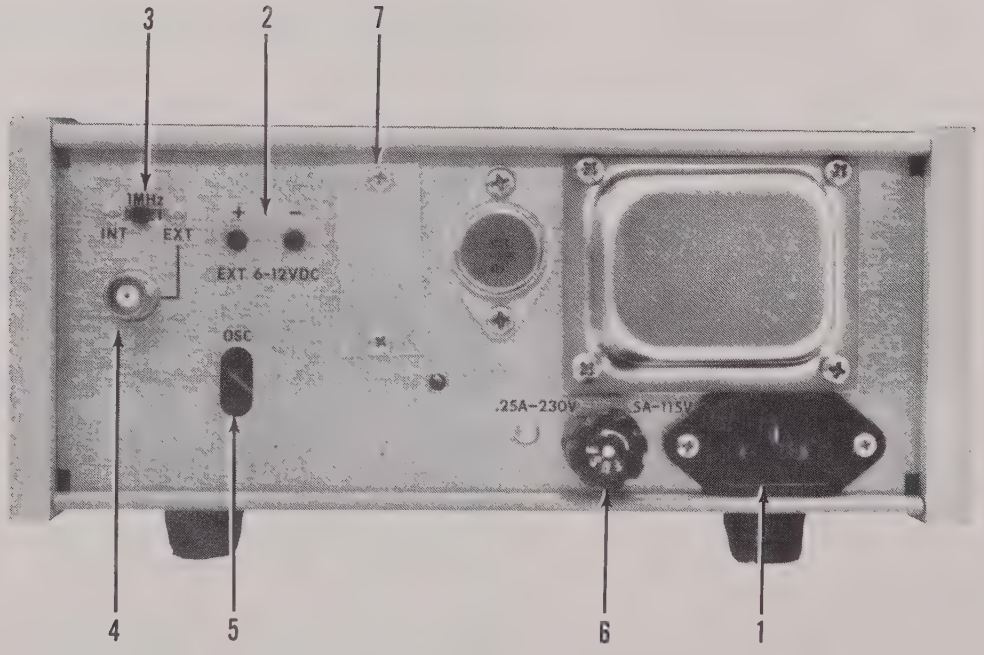

FIGURE 3.2 REAR PANEL

TABLE 3.1 FRONT PANEL FUNCTIONS (Cont'd)

Index	Name	Function
2	RESOLUTION HERTZ (Cont'd)	the 50 Hz-1 KHz TONE RANGE is selected and 0.01 Hz resolution when the 1 KHz-10 KHz TONE RANGE is selected.
	* If either 50 Hz-1 kHz or 1 kHz-10 kHz is selected in the FREQUENCY BAND, the instrument will not operate when the 1000 or 100 resolution switch is depressed.	
3	FREQUENCY BANDS	This interlocked set of four pushbutton switches selects the desired frequency range.
	50 Hz-1 KHz	Selects the 20 Hz-50 MHz input BNC connector. Provides a X1000 multiplication for input signals between 50 Hz and 1 kHz. Resolution switch 10 or 1 must be activated in this mode.
	1 KHz-10 KHz	Selects the 20 Hz-50 MHz input BNC connector. Provides a X100 multiplication of input signals between 1 kHz and 10 kHz. Resolution switch 10 or 1 must be activated in this mode.
	20 Hz-50 MHz	Selects the 20 Hz-50 MHz input BNC connector. Provides a direct count of input signals between 20 Hz and 50 MHz. Any resolution may be selected in this mode.
4	RESET	This momentary pushbutton switch, when depressed, will set all indicators and control functions to their zero state. When the switch is released, a new sample will commence.
5	20 Hz -50 MHz	This BNC connector accepts signals between 20 Hz and 50 MHz.
6	SENSITIVITY	This potentiometer provides a variable input attenuation to signals applied to the 20 Hz-50 MHz input connector. Maximum attenuation is obtained in the full counterclockwise position.
7	Readout/Digits	These seven-segment, eight-digit, readout tubes display the measurement data with decimal point.

TABLE 3.1 FRONT PANEL FUNCTIONS (Cont'd)

Index	Name	Function
8	Readout/kHz	This LED indicator, when lit, shows the measurement to be in kHz as read from the decimal point.
9	Readout/Hz	This LED indicator, when lit, shows the measurement to be in Hertz when read from the decimal point.
10	Readout/OFF SCALE	This LED indicator lights when the readout exceeds 99999.999.
11	Readout/GATE	This LED indicator flashes showing the opening and closing of the gate.

3.3 REAR PANEL FUNCTIONS

The following table describes the controls and connectors on the rear panel of the instrument. Location of the controls and connectors is shown in Figure 3.2.

TABLE 3.2 REAR PANEL FUNCTIONS

Index	Name	Function
1	AC RECEPTACLE	This connector socket allows connection of the ac power to operate the counter.
2	EXT 6-12VDC	These are the connectors for an external battery when Option 07 is installed.
3	INT/EXT	This slide switch selects either the INTernal time base or an EXTernal time base applied to the 1 MHz EXT, BNC connector.
4	1 MHz EXT	This BNC connector provides for an external 1 MHz time base input when the INT/EXT switch is in the EXTernal position.
5	OSC ADJ	These controls allow coarse and fine adjustment of the oscillators.
6	Fuse Holder	0.5 amp fuse for 100-115 V and 0.25 amp fuse for 200-230 V operation.
7	Cover Plate	

3.4 OPERATING PROCEDURES

There are three selectable bands of frequencies which may be measured by the Model 6220A. The 20 Hz-50 MHz input BNC connector is the input for the 20 Hz-50 MHz band, the 50 Hz-1 KHz band, and the 1 KHz-10 KHz band. The 20 Hz-50 MHz band provides direct measurement of the input frequency. The 50 Hz-1 KHz band provides a X1000 multiple of the input frequency when either the 1 Hz or 10 Hz resolution is selected. The 1 KHz-10 KHz band provides a X100 multiple of the input frequency when either the 1 Hz or 10 Hz resolution is selected. In all bands, the indication on the display will be a direct readout.

3.4.1 20 Hz-50 MHz Frequency Band

To measure the frequency of a signal in this band set the counter controls as follows:

Front Panel

POWER	Depress on.
FREQUENCY BAND	Depress the 20 Hz-50 MHz switch.
RESOLUTION	Depress either the 1, 10, 100, or 1000 switch.
RESET	Depress and release.
Signal Input	Connect to the 20 Hz-50 MHz BNC connector.
SENSITIVITY	Full counterclockwise; Rotate clockwise until a stable reading is obtained.

Rear Panel

INT/EXT	Set this switch to INT for operation on the internal time base of the counter or set the switch to EXT for external time base operation.
1 MHz EXT	Connect an external time base, 1 MHz, 1 V rms into 1000 Ω, to this BNC when using the EXT switch position.
EXT 6-12VDC	Connect an external battery to the + and - EXT terminals, when battery operation is required and the 07 DC Operation Option is installed.

3.4.2 1 KHz-10 KHz Frequency Band

To measure the frequency of a signal in this band set the counter controls as follows:

Front Panel

POWER	Depress on.

Front Panel (Cont'd)

FREQUENCY BAND	Depress the 1 KHz-10 KHz switch.
RESOLUTION	Depress either the 1 or 10 switch. (Instrument is inoperative if 100 or 1000 switch is depressed in 1 kHz-10 kHz band).
RESET	Depress and release.
Signal Input	Connect to the 20 Hz-50 MHz BNC connector.
SENSITIVITY	Full counterclockwise; Rotate clockwise until a stable reading is obtained.

Rear Panel

INT/EXT	Set this switch to INT for operation on the internal time base of the counter, or set switch to EXT for external time base.
1 MHz EXT	Connect an external time base, 1 MHz, 1 V rms into 1000 Ω, to this BNC when using the EXT switch position.
EXT 6-12VDC	Connect an external battery to the + and - EXT terminals when battery operation is required and the 07 DC Operation Option is installed.

3.4.3 50 Hz-1 KHz Frequency Band

To measure the frequency of a signal in this band set the counter controls as follows:

Front Panel

POWER	Depress on.
FREQUENCY BAND	Depress 50 Hz-1 KHz switch.
RESOLUTION	Depress either the 1 or 10 switch. (Instrument is inoperative if 100 or 1000 switch is depressed in 50 Hz-1 kHz band).
RESET	Depress and release.
Signal Input	Connect to the 20 Hz-50 MHz BNC connector.
SENSITIVITY	Full counterclockwise; Rotate clockwise until a stable reading is obtained.

Rear Panel

INT/EXT	Set this switch to INT for operation on the internal time base of the counter or set switch to EXT for external time base.
1 MHz EXT	Connect an external time base, 1 MHz, 1 V rms into 1000 Ω, to this BNC when using the EXT switch position.
EXT 6-12VDC	Connect an external battery to the + and - EXT terminals when battery operation is required and the 07 DC Operation Option is installed.

CHAPTER 4
MAINTENANCE

4.1 INTRODUCTION

This chapter contains procedures for maintenance and calibration of the Model 6220A, to aid the user in maintaining the instrument in proper operating condition. Whenever a Systron-Donner instrument requires service, the nearest SD representative should be contacted. He can provide field service, or arrange factory returns, when necessary. Address all inquiries on operation or application to your nearest sales representative; or, Sales Manager:

SYSTRON-DONNER CORPORATION
CONCORD INSTRUMENT DIVISION
10 Systron Drive
Concord, California 94518
Phone: (415) 676-5000
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Cable: SYSTRONDONNER

Specify both model and complete serial number in all correspondence.

4.2 TEST EQUIPMENT

Test equipment recommended for maintaining and checking performance is listed in Table 4.1. Equivalent test equipment having similar characteristics may be substituted when necessary.

TABLE 4.1 RECOMMENDED TEST EQUIPMENT

Type	Characteristic	Recommended Type
Digital Voltmeter	0.1% dc- 1% ac	SD Model 7004A
Signal Generator	10 Hz to 10 MHz	HP Model 651B
Signal Generator	10 MHz to 480 MHz	HP Model 608
Frequency Standard	1 MHz Output	General Technology Model 304B
Oscilloscope	80 MHz Bandwidth, plug-in type	Tektronix Model 581

4.3 PERFORMANCE VERIFICATION

Operation and performance of all circuits in the frequency counter can be verified by the following procedures:

4.3.1 20 Hz-50 MHz Test

1) Set the Counter controls:

RESOLUTION Depress 1

FREQUENCY BANDS	Depress 20 Hz-50 MHz
SENSITIVITY	Maximum clockwise
INT/EXT	INT

2) Connect the 10 MHz to 480 MHz signal generator to the 20 Hz-50 MHz BNC connector on the Counter. Adjust the signal generator for an output of 50 MHz at 25 mV rms. Observe the display is 50000.000 kHz to generator accuracy.

3) Vary the output frequency of the signal generator in a random manner from 50 MHz to 10 MHz. Maintain the signal level at 25 mV rms. Observe the proper indication in the display.

4) Depress the RESET switch and observe that the display resets to zero.

5) Connect the 10 Hz to 10 MHz signal generator and repeat 3) using signals from 20 Hz to 10 MHz.

4.3.2 1 KHz-10 KHz Test

1) Set the Counter controls:

RESOLUTION	Depress 10
FREQUENCY BANDS	Depress 1 KHz-10 KHz switch
SENSITIVITY	Maximum clockwise
INT/EXT	INT

2) Connect the 10 Hz to 10 MHz signal generator to the 20 Hz-50 MHz BNC connector. Adjust the signal generator for an output of 1 kHz, 25 mV rms. Observe the display is 1000.0 Hz to generator accuracy.

3) Vary the signal generator frequency from 1 kHz to 10 kHz, maintain 25 mV rms, and note the proper indication on the display.

4) Set the signal generator to a frequency of 25 kHz. Note the indication is zero.

5) Remove the signal generator from the input connector. Note the indication remains at zero.

4.3.3 50 Hz-1 KHz Test

1) Set the Counter controls:

RESOLUTION	Depress 1
FREQUENCY BANDS	Depress 50 Hz-1 KHz switch
SENSITIVITY	Maximum clockwise
INT/EXT	INT

2) Connect the 10 Hz to 10 MHz signal generator to the 20 Hz-50 MHz BNC connector. Adjust the signal generator output to 1 kHz,

25 mV rms. Observe the display is 1000.0 Hz to generator accuracy.

3) Vary the signal generator frequency from 1 kHz down to 50 Hz, maintain 25 mV rms, and note the proper indication on the display.

4) Set the signal generator frequency to 2.5 kHz. Note the indication is zero.

5) Remove the signal generator from the input connector. Note the indication remains at zero.

4.3.4 External Standard Test

1) Set Counter controls as follows:

RESOLUTION	Depress 1
FREQUENCY BANDS	Depress 20 Hz-50 MHz
SENSITIVITY	Maximum clockwise
INT/EXT	INT

2) Connect the 10 Hz to 10 MHz signal generator to the 20 Hz-50 MHz BNC connector. Adjust the signal generator frequency to 1 MHz at 25 mV rms.

3) Connect a 1 MHz standard generator to the 1 MHz IN BNC connector on the rear panel.

4) Change the INT/EXT switch on the rear panel from INT to EXT. Observe no change in display.

4.4 ROUTINE MAINTENANCE

A regular program for maintenance and inspection every five to six months is recommended for this unit. As part of these regular procedures, the instrument should be checked in the following manner:

1) Disconnect ac power and remove the top and bottom covers.

2) Make a thorough visual inspection of all wiring and cables. Check for frayed, loose, or burned wires.

3) Check the physical integrity of all components. Look for burned or cracked components, loose solder connections, leakage of insulation compounds, and general physical damage. When a printed-circuit board contains integrated circuit packages, ensure that all packages are firmly mounted. Never unnecessarily remove and replace a package.

4) Check all front panel switches and controls for loose or broken terminals, loose or sticking shafts, etc.

5) If the internal panel surfaces and components have an excessive amount of dust deposited on them, use a soft brush and low-pressure stream of air to remove the foreign material.

CAUTION

Do not clean P.C. boards or small internal components with a stiff brush or solvents, since damage to the circuits may result. A high-powered vacuum cleaner device should not be used on small internal components.

6) Wipe the external surfaces of the instrument with a soft damp cloth to remove dirt, fingerprints, and other foreign materials.

7) Replace the top and bottom covers and reconnect ac power. Check instrument performance in accordance with procedures given in Section 4.3. If performance does not match or exceed the specifications listed in Chapter 1 of this manual, corrective maintenance may be required.

4.5 PRINTED-CIRCUIT BOARD REPAIR

When replacing integrated circuits or other electronic components soldered to printed-circuit boards, the procedures indicated below must be followed or damage to the board may result:

1) Determine by troubleshooting techniques, which integrated circuit or discrete component(s) has failed.

2) Remove the defective component(s) from the board by cutting the pins or leads with a small diagonal clipping tool. (Always remove and replace the entire component).

3) Apply heat (40-50 W soldering iron) sparingly to each of the cut pins or leads and remove from the board; clean the hole(s) with a toothpick or solder suction tool.

4) Form the tinned leads of the replacement part and insert in the printed-circuit holes; solder, then trim leads to extend 1/16-inch beyond the back surface of the board. (Use only 63-37 solder with maximum 1/16-inch diameter).

CAUTION

Always trim semiconductor leads only after soldered installation is complete. This procedure greatly lessens the possibility of component failure due to shock-wave damage caused by the trimming tool.

5) When soldering semiconductor devices and all small components, be sure to use a heat sink tool or long-nosed plier connected to the component lead(s) while each is being soldered. Allow the soldered connection to cool before removing the heat sink.

6) Clean all dirt and solder-flux from the printed circuit traces by liberal application of isopropyl alcohol or freon-type solvents.

4.6 CALIBRATION

4.6.1 Amplifier Adjustment, A3

1) Set controls:

SENSITIVITY	Maximum clockwise
RESOLUTION	Depress 1000
FREQUENCY BANDS	Depress 20 Hz-50 MHz

2) With the digital voltmeter, monitor TP1 on the amplifier.

3) Adjust BIAS, R7, for a reading of +2 V dc ±100 mV.

4) Connect the 10 MHz to 480 MHz generator to the 20 Hz-50 MHz BNC connector. Adjust the signal generator to a frequency of 50 MHz at 100 mV rms. Observe 50000 kHz on the display.

5) Decrease input signal amplitude and adjust the trigger level control, R25, until the best sensitivity is obtained. This should be a signal amplitude of approximately 20 mV rms.

4.6.2 Oscillator Adjustment, A5

1) Set controls:

RESOLUTION	Depress 1
FREQUENCY BANDS	Depress 20 Hz-50 MHz switch

2) Connect the 1 MHz frequency standard to the 20 Hz-50 MHz BNC connector.

3) Adjust the OSC ADJ on the rear panel for a reading of 1000000 Hz ±1 count.

4) As an alternate method of adjusting the oscillator, connect the 1 MHz frequency standard to the external sync of the oscilloscope.

5) Connect the vertical input of the oscilloscope to terminal 28 on the Logic board, A1. Adjust C1 for a drift of 1 cycle per second or less, on the oscilloscope display.

4.6.3 Amplifier, A3, R1 Selection Procedure

1) Set controls:

SENSITIVITY	Maximum counterclockwise
RESOLUTION	Depress 1000
FREQUENCY BANDS	Depress 20 Hz-50 MHz

2) With a suitable jumper, short across R1.

3) Connect the 10 Hz to 10 MHz signal generator to the 20 Hz-50 MHz BNC connector. Adjust the signal generator to a frequency of 1 kHz at 300 mV peak-to-peak.

4) Connect the oscilloscope to the junction of R4 and R5.

5) Rotate R2, SENSITIVITY, slowly clockwise and note the amplitude increase indicated on the oscilloscope. Continue the rotation of R2 until the amplitude no longer increases.

6) With R2 at the point where signal amplitude no longer increases, measure the dc voltage on the wiper arm of R2.

7) Rotate R2 maximum clockwise.

8) Remove the short across R1. Select a resistor value to give the same dc voltage reading at the wiper arm of R2 as was obtained in 6) above.

CHAPTER 5
FUNCTIONAL DESCRIPTION

5.1 INTRODUCTION

Chapter 5 contains an operational description at the block diagram level and detail descriptions of each "A" numbered board contained in the instrument. Referenced schematics are contained in Chapter 6 and wiring interconnects are shown in Wiring Interconnect Schematic #7-053645. This manual may contain revised or updated information reflecting certain changes in production requirements. This supplemental information will be contained in Chapter 8; or, in some cases, may be added to the descriptions in this chapter.

5.2 PRINCIPLES OF OPERATION

The Model 6220A is an integrated-circuit, frequency counter that measures the frequency of a signal. The measuring techniques compare the frequency of an unknown signal to a time base derived from a reference frequency.

Figure 5.1 is a functional block diagram of the instrument. The system consists of front panel controls, input amplifier-shaper, multiplier, function select logic, function control logic, time base, oscillator reference, decade counters, readout unit, and power supply. The frequency band switches, on the front panel, connect the function select logic. The resolution switches select a time base reference signal. The combined positions of the two switches determine the proper decimal point placement and measurement unit indication in the readout.

When an unknown signal is connected to the instrument, the input amplifier-shaper converts the signal into a rectangular waveform. The rectangular waveform is converted into counting pulses that are directed to the decade counters, when the count gate is opened by the selected time base.

The serial data is converted into BCD format by the decade counters. Then the BCD data is decoded into decimal outputs by the decoder driver. The decoder driver drives seven-segment readout tubes that indicate the measurement, along with measurement unit indications, and decimal point placement. Display time of the measurement, independent of gate time, is fixed at approximately 100 ms. The readout unit continuously displays the most recent measurement at the end of each gate time.

5.3 LOGIC DEVICES

Logic board Schematic #7-05365201 contains a list of typical logic devices found in this instrument.

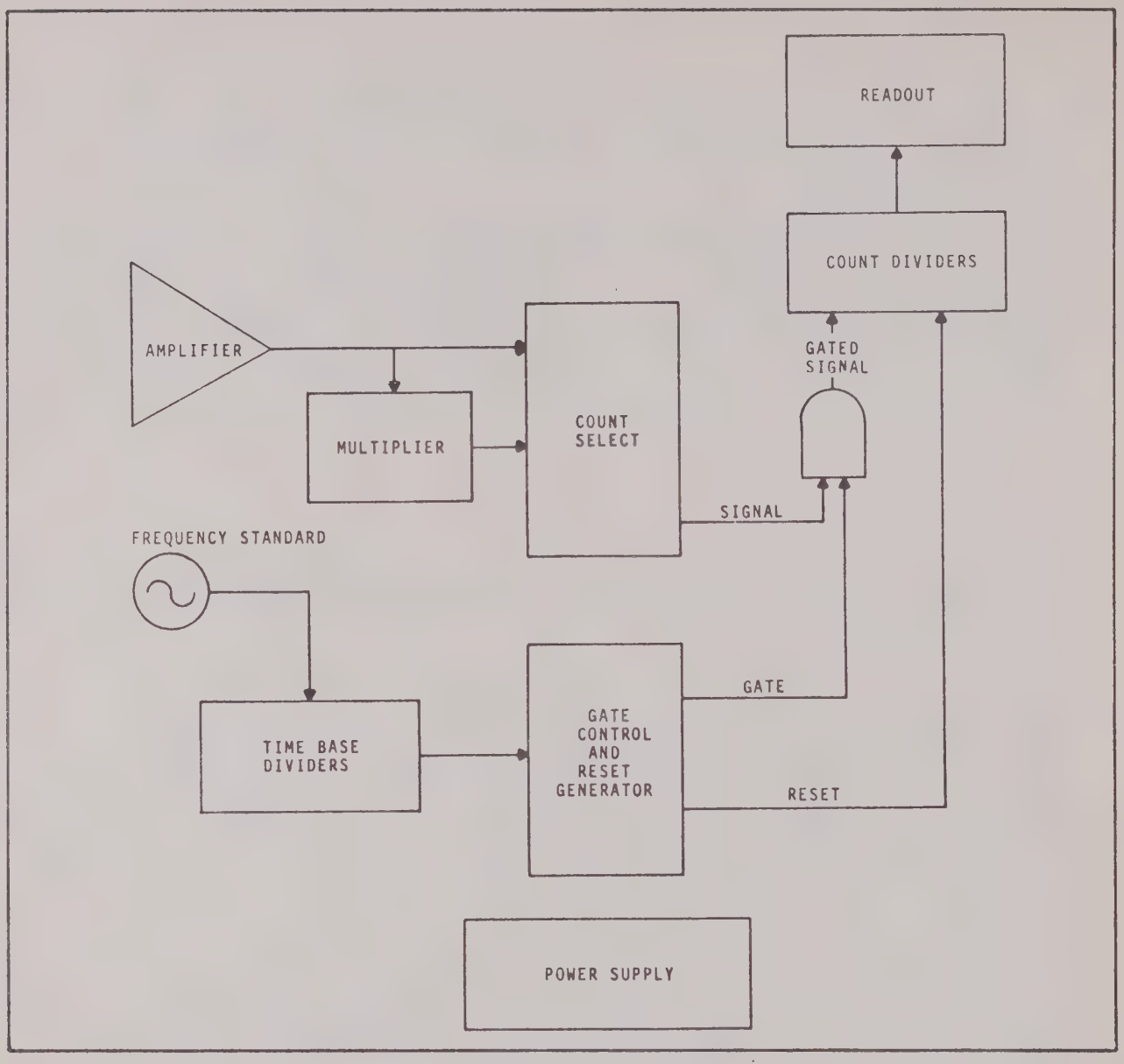


FIGURE 5.1 FUNCTIONAL BLOCK DIAGRAM

5.4 CIRCUIT DESCRIPTIONS

This section contains a description for each "A" numbered assembly, arranged in alpha-numeric order.

5.4.1 A1, Logic Assembly, Schematic #7-05365201

The Logic board assembly consists of ten major circuit groups; power supply, time base, control binaries count gate, control, zero suppression, decimal and legend logic, count chain, multiplex, off scale, gate light, and frequency multiplier.

The power supply consists of line filters, L1, C1, L2, C2, transformer T1 and three full wave rectifiers, along with control and regulating circuitry. The dc outputs are +180 V, through Q1 regulator; +9 V is applied to regulator U1, Q3, to produce +5 V and -18 V is regulated through U2, Q4, for an output of -12 V.

Time base selection is accomplished by controlling the programmable divider chain, U31, containing six programmable decades. The 10 MHz frequency standard is divided by U3 to provide a 1 MHz clock frequency. The time base is selected by depressing the desired RESOLUTION and FREQUENCY BAND switches.

Control binaries, U32, U33, accept start-stop information from the time base divider, U31. The second section of U32 is the first binary of the count chain. This section is controlled by U32-5, while counting inputs from U22.

Recycling of the instrument is accomplished through the reset one-shot, U15, C21. The fixed recycle rate of the instrument is controlled by one-shot, U15, C20. The transfer one-shot, U16, C19, updates the display at each end-of-count signal.

Zero suppression is controlled by the most significant digit, and the decimal placement through U17, U18, U23, U27, U28, U29, and U30. As pin 13 of U37 through U44 is activated, a control line, internal to the circuit, provides a blanking code to the summed output lines.

Decimal and legend information is selected by the resolution and band switches. The decimal information is sensed by U29, which provides the required drive for the decimal point indicators. Legend information is developed by U24 to drive the legend indicator.

The count chain consists of U32, U33, U37 through U41, and U44. U42 is the storage element and transfer for the high speed decade, U32, U33. U37 through U41, and U43, U44 are combined decade storage devices which can parallel outputs for multiplex purposes. Blanking code information is also contained in these devices.

Multiplex is accomplished by the free-running oscillator, U36, clock register, U35, and decoder, U34. The decoder times the sequence of multiplexing and the readout is interlaced multiplex for a proper visual indication.

Off scale is sensed by U20, U25, and U26. The circuit is designed so that U25-9 assumes the same state as U25-5 at each transfer pulse. When the most significant digit carries, U25-5 toggles. This output enables U26-13. The next transfer pulse toggles U25-9. The gate light drive, for extending the short time base condition, is provided by one-shot, U16, C24. The true gate and extended gate are summed in U17 for proper drive to U26.

The frequency multiplier is a phase/frequency-locked voltage controlled oscillator comprised of phase/frequency detector, U7, oscillator,

Q8, and decade dividers, U11, U12, U13. Input from the amplifier is applied to U7-1 while the oscillator frequency, divided by either 100 or 1000 by decade counters, U11, U12, U13, is applied to U7-3. A phase or frequency difference at the inputs to U7 will generate a dc level through Q6 at the junction of C11, C14, R18, R19. This voltage, amplified by Q7, controls oscillator Q8. The resultant output of Q8 is a signal in phase with the amplifier input, multiplied by 100 or 1000. Multiplication is controlled by the 50 Hz-1 kHz and 1 kHz-10 kHz TONE RANGE switches. A lockout circuit, U8, U9, U10, U14, prevents the VCO output from being counted when the input from the amplifier is out of the selected frequency band range.

5.4.2 A2, Readout Assembly, Schematic #45586-7-1

The Readout assembly consists of the following major circuit groups; display readout, display decoder driver, units indicators, decimal decoder-driver, off-scale (OS) indicator, and gate indicator.

The display readout includes eight in-line, horizontal tubes of the neon-filled, cold-cathode discharge type. As the cathodes are grounded, the elements ionize the gas, thus, producing the numerical display. Current through the tubes is limited by the decoder-driver, U2.

The display decoder-driver accepts a binary-coded decimal input and converts the information to an output suitable for grounding the display tube cathodes.

The anodes of the seven-segment readout device are activated by a sequenced level, timed to turn the various anodes on, by Q1 through Q16, at a time the cathodes are coded correctly. This multiplexing occurs at a frequency of approximately 2 kHz.

The measurement indicators accept a ground signal from the legend logic and convert it to a visual output of the annunciator unit.

The decimal driver, U1, accepts binary-coded decimal information from the decimal logic and converts it to one-of-ten outputs suitable for lighting the decimals contained within the display tubes.

Off-Scale (OS) indication is obtained by sensing the carry output of the last decade in the chain.

5.4.3 A3, Amplifier Assembly, Schematic #7-05311301

The amplifier consists of a variable attenuator, R4, R5, Q1, and impedance changing circuit, Q2, Q3, a gain circuit, Q4, Q5, Q6, and a shaper, U1, along with associated circuitry for each.

The effective resistance of field-effect-transistor, (FET), Q1 is varied by the sensitivity control, R2. This variable resistance, along with fixed resistors, R4, R5, provides the means of varying the signal strength applied to the impedance changing circuit, Q2,

Q3, and the associated circuitry. Voltage gain is obtained in Q4, Q5, and current gain in Q6. The operating level of Q6 is varied by the trigger level control, R25, to set the Q6 output level to the input level required by Schmitt trigger, U1-8, U1-11. The outputs of U1-3 and U1-6 are used to drive the 20 Hz-50 MHz circuitry on the logic board.

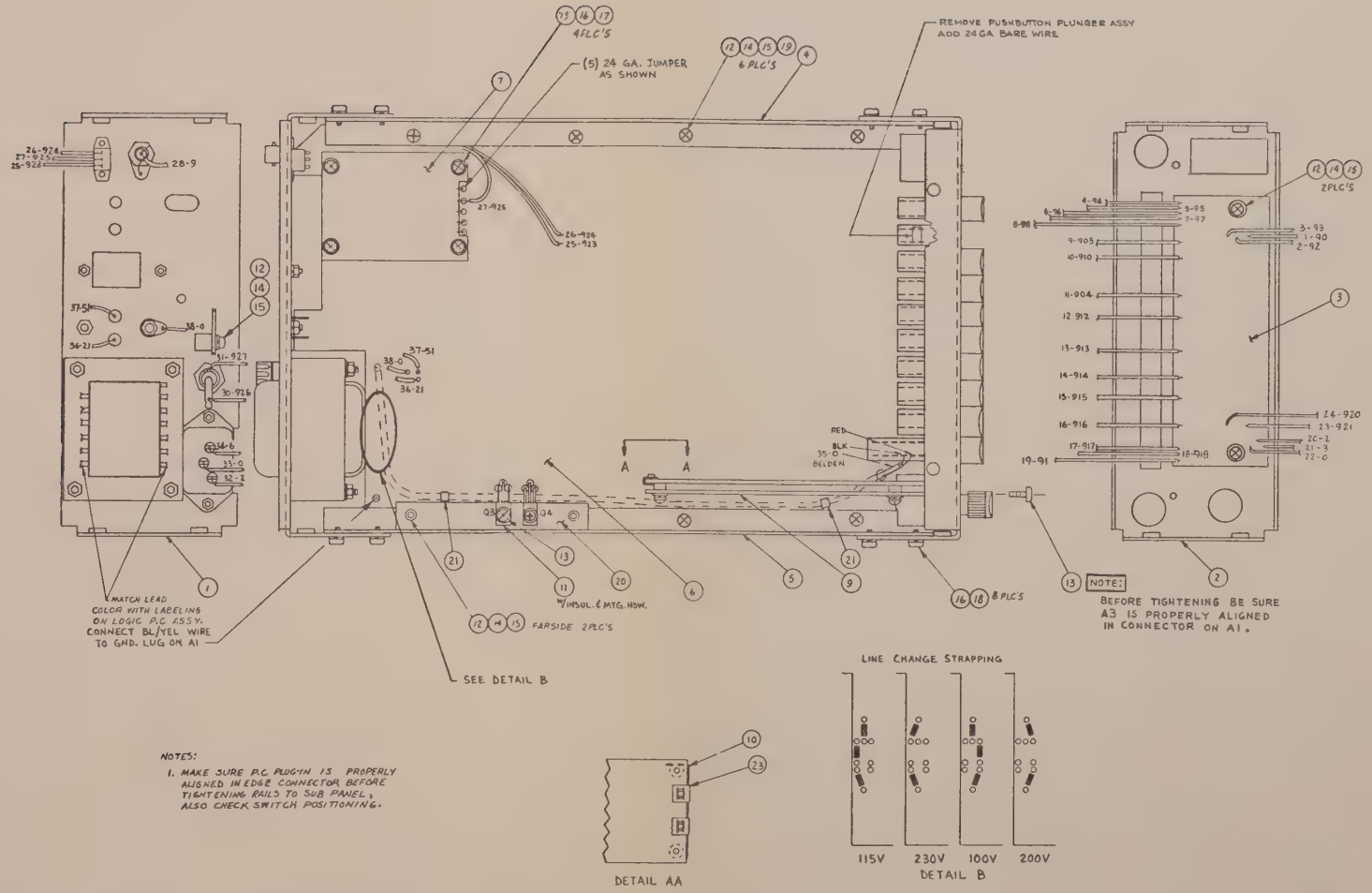
5.4.4 A5, Oscillator Assembly, Schematic #7-05318301

The 10 MHz oscillator consists of a quartz crystal controlling a Colpitts circuit. This oscillator provides the standard frequency to which all unknown frequencies are compared. The output can be calibrated to a standard by adjusting the variable capacitor, C2.

CHAPTER 6
DRAWINGS

6.1 INTRODUCTION

This chapter contains the assembly/schematic drawings for the instrument. They are arranged with the structural assemblies first, followed by the "A" numbered board assemblies in alpha-numeric order.



NOTES:

1. MAKE SURE P.C. PLUG-IN IS PROPERLY ALIGNED IN EDGE CONNECTOR BEFORE TIGHTENING RAILS TO SUB PANEL, ALSO CHECK SWITCH POSITIONING.

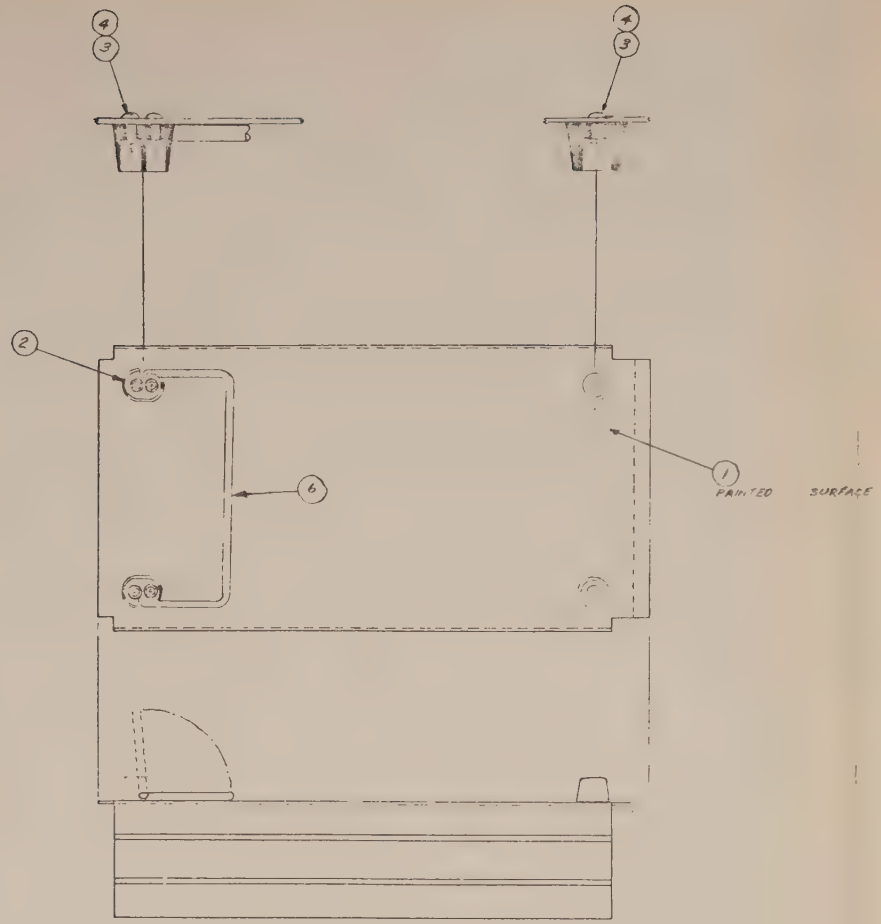
DETAIL AA

LINE CHANGE STRAPPING

115V 230V 100V 200V

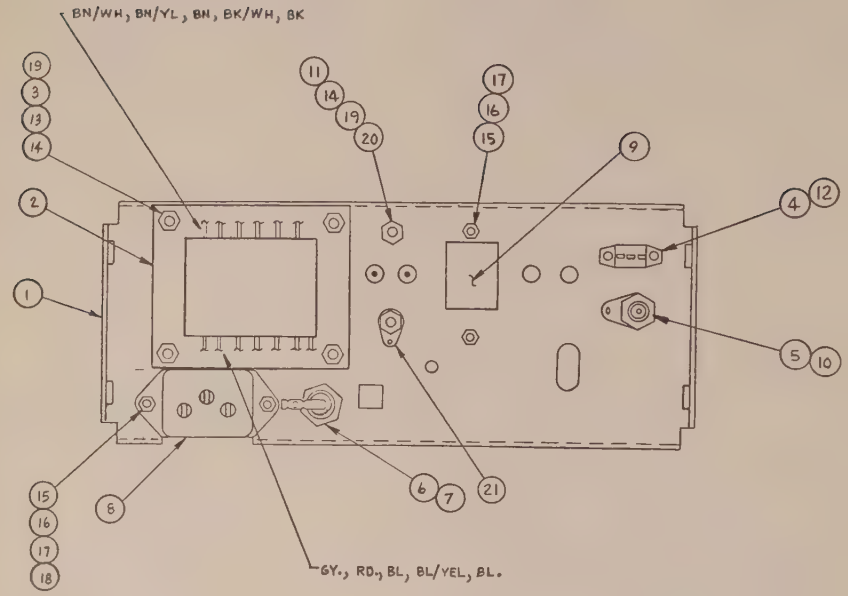
DETAIL B

TEST ASSEMBLY #053647 REV A



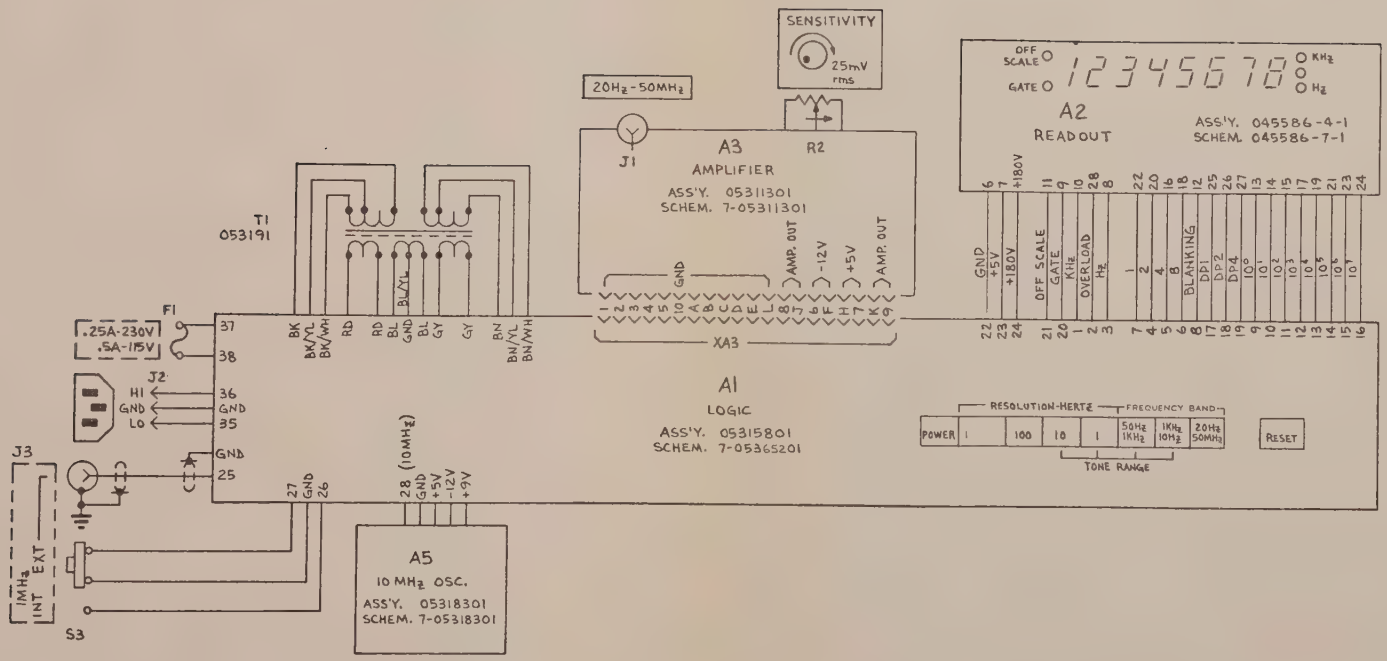
BOTTOM COVER ASSEMBLY #04506503

REV C



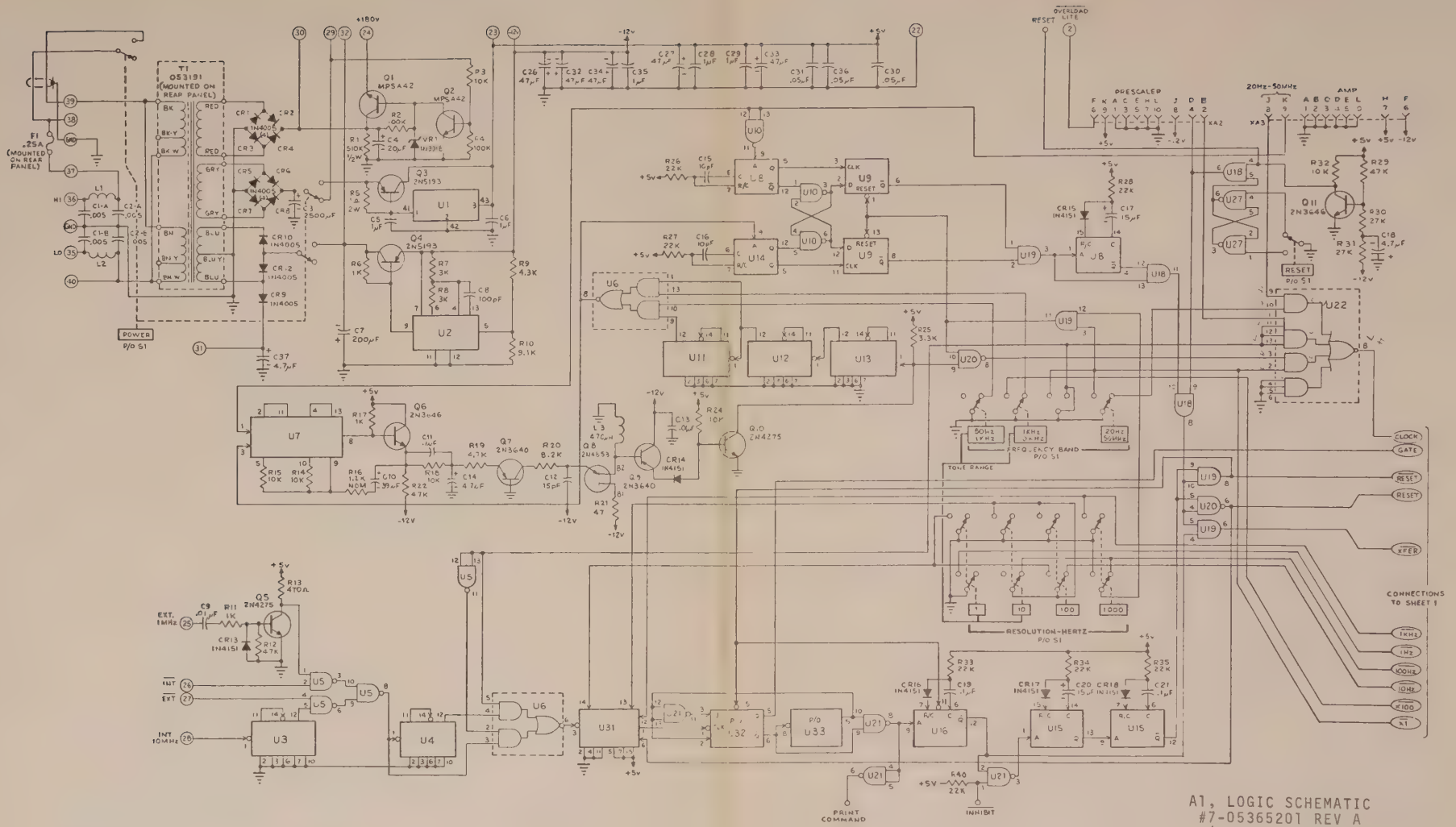
REAR PANEL ASSEMBLY #053217

REV B

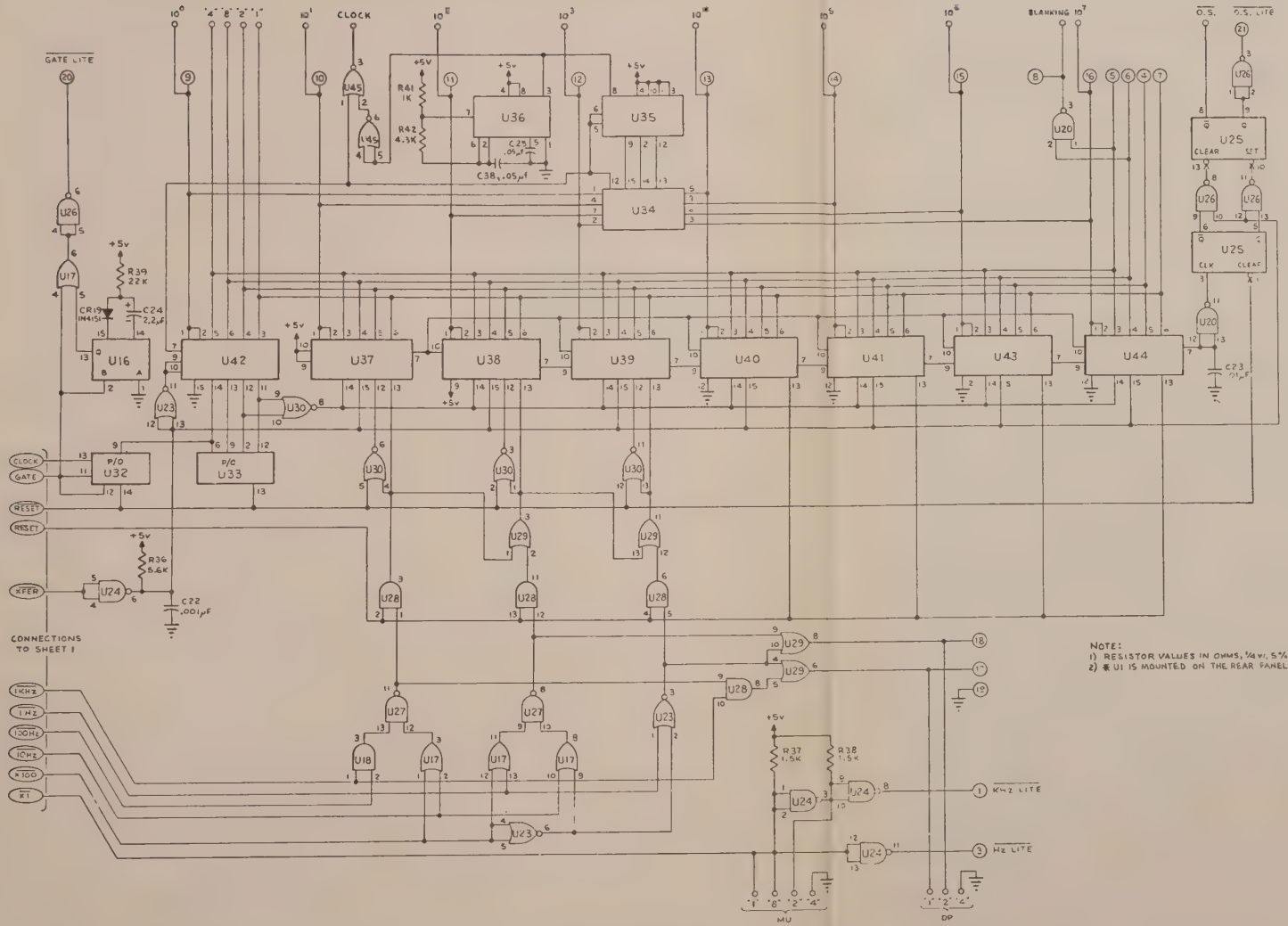


WIRING INTERCONNECT DIAGRAM

#7-053645 REV A



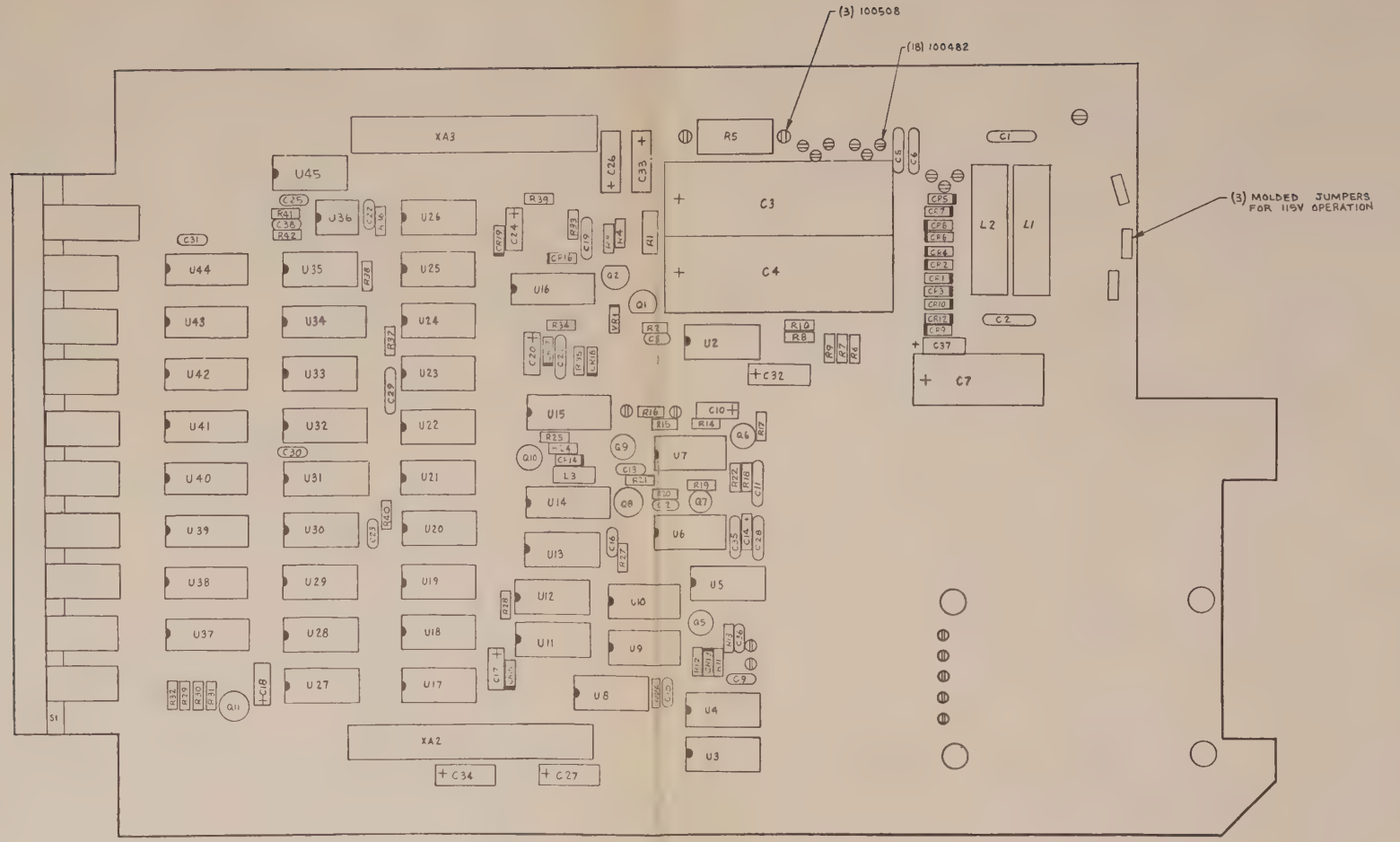
A1, LOGIC SCHEMATIC
#7-05365201 REV A
(Sheet 1 of 2)



NOTE:
1) RESISTOR VALUES IN OHMS, ¼w, 5%.
2) * U1 IS MOUNTED ON THE REAR PANEL.

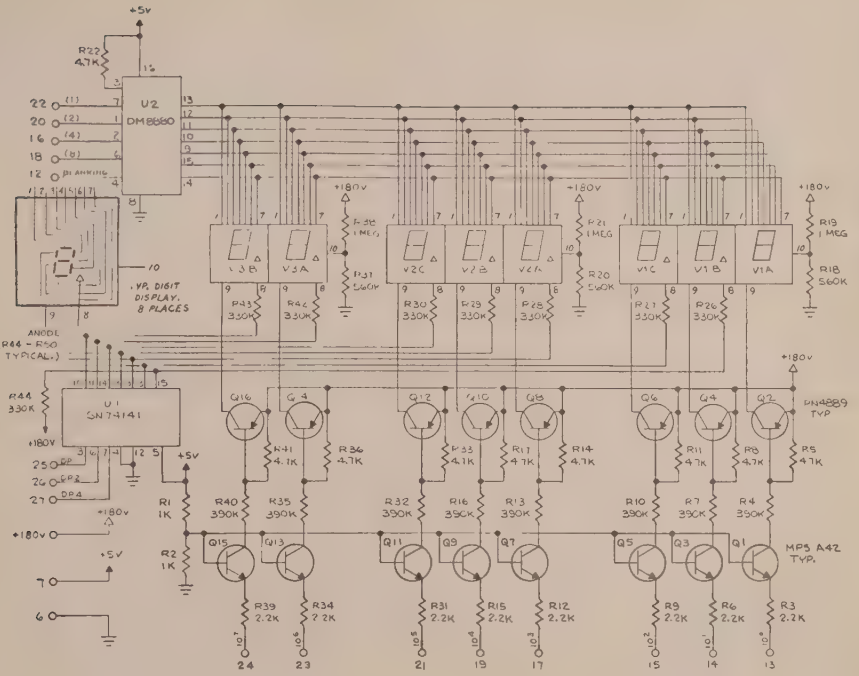
#		TYPE	+5v	-12v	GND
	U1	LM309K			
	U2	U6A723C			
	U3	SN7490N	5		10
	U4	↓	5		10
	U5	SN7400N	14		7
	U6	SN7451N	14		7
	U7	MC4044P	14		7
	U8	SN74123N	16		8
	U9	SN7474N	14		7
	U10	SN7400N	14		7
	U11	SN7490N	5		10
	U12	↓	5		10
	U13	↓	5		10
	U14	SN74123N	16		8
	U15	↓	16		8
	U16	↓	16		8
	U17	MC3003P	14		7
	U18	MC3001P	14		7
	U19	↓	14		7
	U20	SN7400N	14		7
	U21	↓	14		7
	U22	SN74S64N	14		7
	U23	MC3002P	14		7
	U24	SN7426N	14		7
	U25	SN7474N	14		7
	U26	SN7426N	14		7
	U27	SN7400N	14		7
	U28	MC3001P	14		7
	U29	MC3003P	14		7
	U30	MC3002P	14		7
	U31	MK5009	13	-6	2
	U32	SN74S112N	14		7
	U33	SN74196N	16		8
	U34	SN7442N	16		8
	U35	NE281N	14		7
	U36	NE555V	8		1
	U37	DM85LS2	16		8
	U38		16		8
	U39		16		8
	U40		8		8
	U41	↓	16		8
	U42	DM85LS1	16		8
	U43	DM85LS2	16		8
	U44	↓	16		8
	U45	MC3002P	14		7

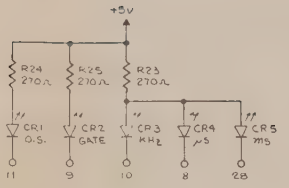
A1, LOGIC SCHEMATIC
#7-05365201 REV A
(Sheet 2 of 2)



A1, LOGIC ASSEMBLY #05315801

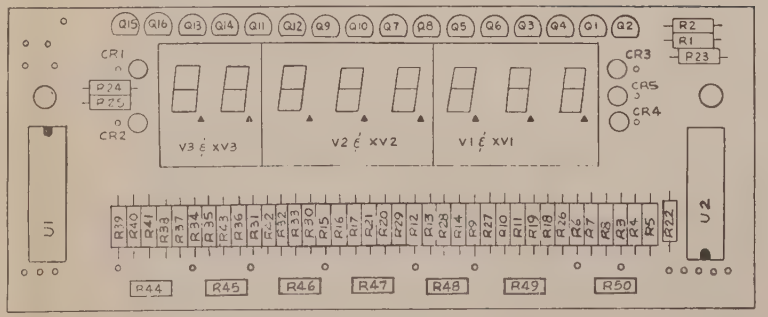
REV D

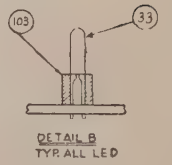




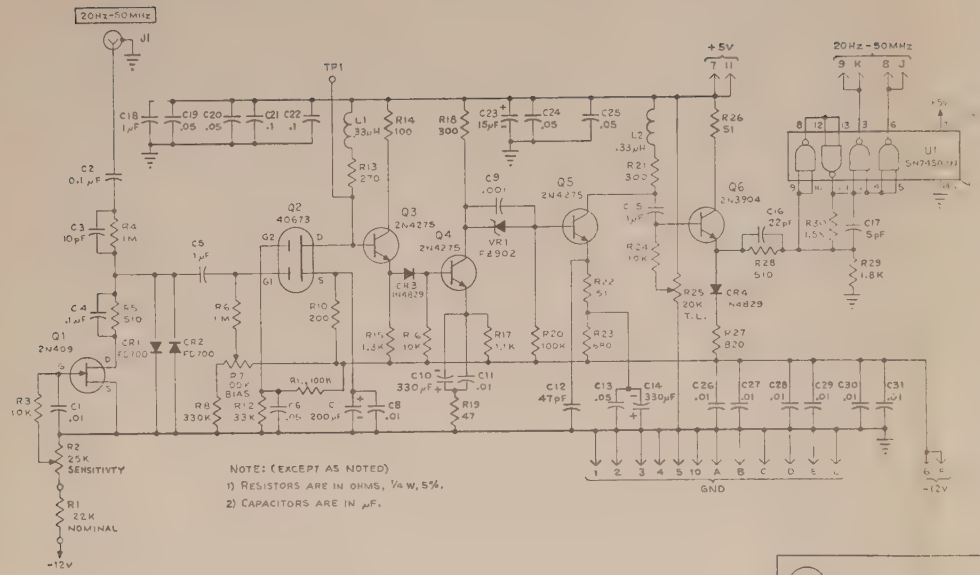
NOTES: UNLESS NOTED OTHERWISE
1) RESISTORS: 1/4W 5%
2) STROBE CODE = 1-4-7-2-5-8-6-3.

A2, READOUT SCHEMATIC
#45586-7-1 REV B



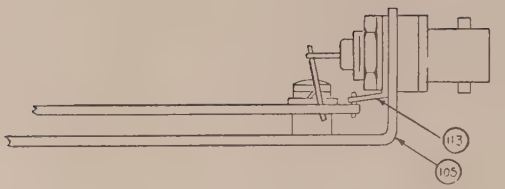


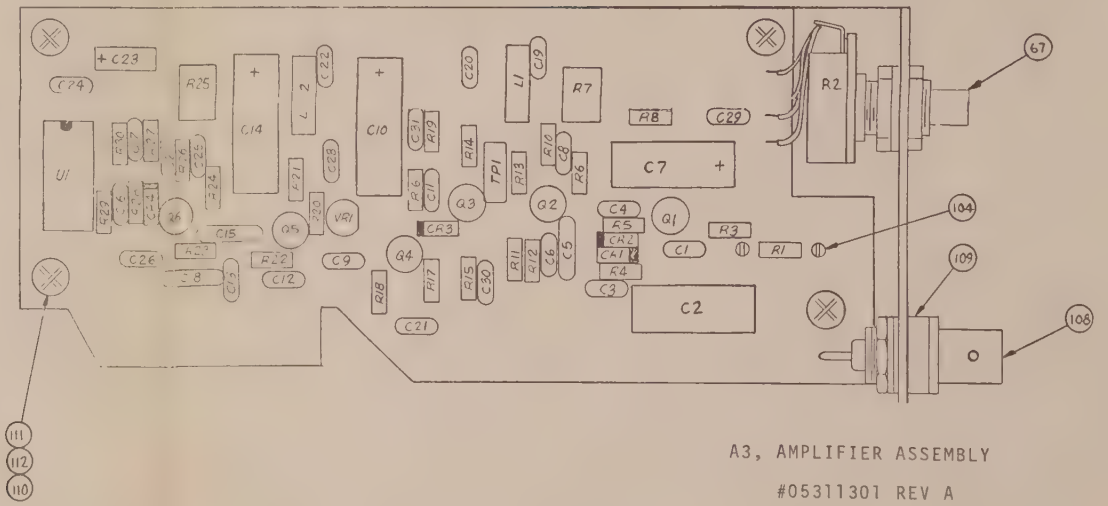
A2, READOUT ASSEMBLY
#45586-4-1 REV B



A3, AMPLIFIER SCHEMATIC

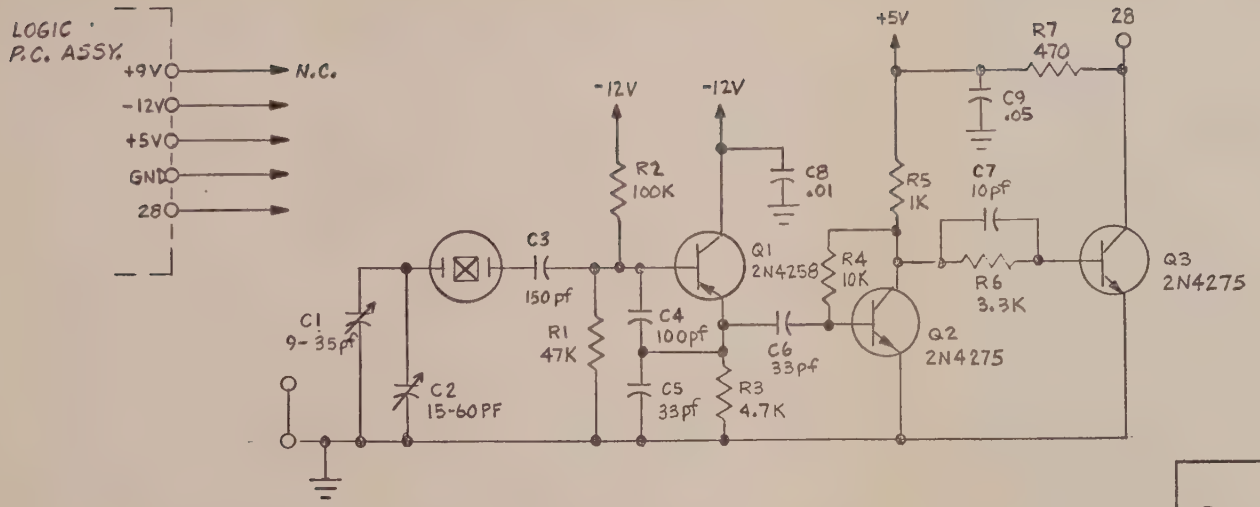
#7-05311301 REV A





A3, AMPLIFIER ASSEMBLY

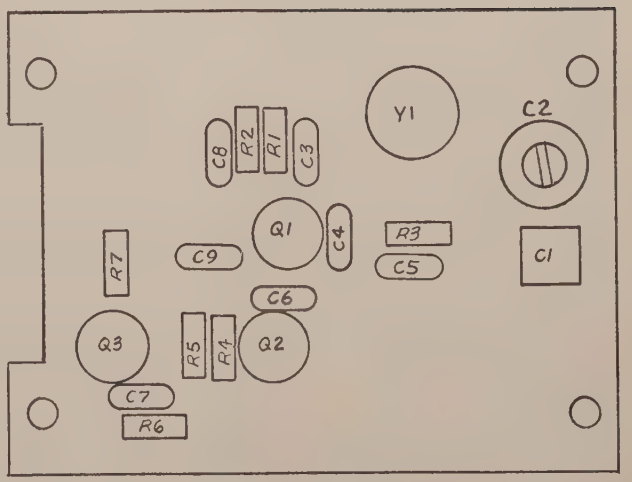
#05311301 REV A



NOTES: UNLESS OTHERWISE SPECIFIED,
1. ALL RESISTORS 1/4 W, 5%.
2. ALL CAPACITORS IN μf.

A5, OSCILLATOR SCHEMATIC

#7-05318301 REV A



A5, OSCILLATOR ASSEMBLY

#05318301 REV A

CHAPTER 7
PARTS LISTS

7.1 INTRODUCTION

This chapter lists all replaceable parts contained in the Model 6220A. A list of manufacturer's by code, name and address is also included.

TABLE 7.1 CODE-TO-NAME INDEX

Code	Name	Address
00853	Sangamo Electric Co. S. Carolina Div.	P.O. Box 128, Pickens, S.Carolina 29671
01121	Allen-Bradley Co.	1201 S. 2nd St., Milwaukee, Wis. 53204
01295	Texas Instruments Inc.	13500 N. Central Expressway, Dallas, Texas 75231
02735	RCA Corp., Solid State Div.	Rt. 202, Somerville, N.J. 08876
03508	General Electric Co. Semiconductor Prods.	Electronics Park, Syracuse, N.Y. 13201
03877	Transitron Electronic Corp.	168-186 Albion St., Wakefield, Mass. 01880
04713	Motorola Semiconductor Products	5005 E. McDowell Rd., Phoenix, Ariz. 85008
05574	Viking Industries Inc.	21001 Nordhoff, Chatsworth, Ca. 91311
06540	Amatom Electronic Hardware, Div. of Mite Corp.	81 Rockdale Ave., New Rochelle, N.Y. 10806
06560	Airco Speer Electronics	P.O. Box 1692, Grand Plaza, 945 Grand Ave., Nogales, Ariz. 85621
07263	Fairchild Camera & Instrument Corp., Semiconductor Div.	313 Frontage Rd., Mt. View, Ca. 94040
07933	Raytheon Co., Semiconductor Div.	350 Ellis St., Mt. View, Ca. 94040
13324	Herculite Protective Fabrics Inc.	1107 Broadway, New York, N.Y. 10010

TABLE 7.1 CODE-TO-NAME INDEX (Cont'd)

Code	Name	Address
13715	Fairchild Camera & Instrument Corp., Semiconductor Div.	4300 Redwood Hwy., San Rafael, Ca. 94903
15933	Systron-Donner Corp. Datapulse Div.	10150 W. Jefferson Blvd., Culver City, Ca. 90230
18324	Signetics Corp.	811 E. Arques, Sunnyvale, Ca. 94086
21604	Buckeye Stamping Co.	555 Marion Rd., Columbus, Ohio 43207
27014	National Semiconductor Corp.	2950 San Ysidro Way, Santa Clara, Ca. 95051
28480	Hewlett-Packard Co.	1501 Page Mill Rd., Palo Alto, Ca. 94304
50088	Mostek Corp.	1400 Upfield Dr., Carrollton, Texas 75006
56289	Sprague Electronic Co.	North Adams, Mass. 01247
71590	Globe-Union Inc. Centralab Div.	P.O. Box 591, Milwaukee, Wis. 53201
72136	Electro Motive Mfg. Co. Inc.	S. Park & John Sts., Willimantic, Conn. 06226
72259	Nytronics Inc.	550 Springfield Ave., Berkeley Heights, N.J. 07922
72982	Erie Technological Products Inc.	644 W. 12th St., Erie, Pa. 16512
74970	Johnson, E.F., Co.	299 10th Ave. S.W., Waseca, Minn. 56093
75042	TRW Electronic Components IRC	401 N. Broad St., Philadelphia, Pa. 19108
75915	Littlefuse Inc.	800 E. Northwest Hwy., Des Plaines, Ill. 60016
76493	Miller J.W. Co.	P.O. Box 5825, 19070 Reyes Ave., Compton, Ca. 90024
80294	Bourns Inc.	1200 Columbia Ave., Riverside, Ca. 92507
82389	Switchcraft Inc.	5555 N. Elston Ave., Chicago, Ill. 60630

TABLE 7.1 CODE-TO-NAME INDEX (Cont'd)

Code	Name	Address
91418	Radio Materials Co.	4242 W. Bryn Mawr, Chicago, Ill. 60646
91506	Augat Inc.	33 Perry Ave., Attleboro, Me. 02703
99392	STM	2904 Chapman St., Oakland, Calif. 94601
99515	Marshall Industries Capacitor Div.	1960 Walker Ave., Monrovia, Ca. 91016

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION: FINAL ASSEMBLY #053645

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
		SHIPPING ASSEMBLY #053645				
		ASSEMBLY, Test	52542	053647	053647	1
		PANEL, Decorative	52542	053646	053646	1
		NAMEPLATE	52542	023456	023456	1
		KNOB	07933	50-2WD-1G	102764	1
		WINDOW	52542	04559361	04559361	1
		TRIM, Front	52542	03723061	03723061	2
		TRIM, Side	52542	03985903	03985903	2
		COVER, Bracket Mounting	52542	039857	039857	2
		HANDLE	52542	03357003	03357003	2
		TRIM, End	52542	039033	039033	4
		COVER, Top	52542	03356703	03356703	1
		ASSEMBLY, Cover Bottom	52542	04506503	04506503	1
		consisting of the following:				
		COVER, Bottom	52542	04501303	04501303	1
		FEET, Set of 4	21604	PP40012&40013	101059	1
		Bail, Short	15933	32000-716	101057	1
		TEST ASSEMBLY #053647				
	A1	ASSEMBLY, Logic	52542	05315801	05315801	1
	A2	ASSEMBLY, Readout	52542	45586-4-1	45586-4-1	1
	A3	ASSEMBLY, Amplifier	52542	05311301	05311301	1
	A5	ASSEMBLY, Oscillator	52542	05318301	05318301	1
	Q3	TRANSISTOR, Silicon, PNP	04713	2N5193	101405	2
	Q4	Same as Q3				
		RAIL, Side Left	52542	053116	053116	1
		RAIL, Side Right	52542	053115	053115	1
		PANEL, Sub Front	52542	053099	053099	1
		HEATSINK, Left	52542	053189	053189	1
		REAR PANEL ASSEMBLY #053217				
		TRANSFORMER	52542	053191	053191	1
		RECEPTICLE, RF BNC	52542	UG-1094/U	101155	1
		POST, Fuse	75915	342004	102409	1
		FUSE, 1/2 A 3AGMB	75915	312.500	100595	1
		CONNECTOR, Male	82389	EAC-301	101288	1
		COVER, Plate Connector	52542	02139811	02139811	1
		BELL, End	52542	04561761	04561761	1
		PANEL, Rear	52542	05312691	05312691	1
	U1	INTEGRATED CIRCUIT, Voltage Regulator	27014	LM309K	025787	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A1, LOGIC ASSEMBLY #05315801

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
		ASSEMBLY	52542	05315801	05315801	
		SCHEMATIC	52542	7-05365201	7-05365201	
	C1	CAPACITOR, Disc, 2 X .005 µF, 1.4 kV	56289	125L2D50/29C147	102615	2
	C2	Same as C1				
	C3	CAPACITOR, El Ax, 2000-4400 µF, 15 V	99392	33C15CL252	100247	1
	C4	CAPACITOR, El Ax, 20 µF, 350 V	56289	39D206F350FL4	100226	1
	C5	CAPACITOR, Disc, 1 µF, 25 V	56289	5C023105X0250B3	100176	5
	C6	Same as C5				
	C7	CAPACITOR, El Ax, 200 µF, 25 V	56289	TE1213	102582	1
	C8	CAPACITOR, Dip Mica, 100 pF, 500 V	72136	DM15FD101J0	10017301	1
	C9	CAPACITOR, Disc, .01 µF, 100 V	91418	TA110	100103	3
	C10	CAPACITOR, Tant, 39 µF, 10 V	56289	150D396X9010B2	100183	1
	C11	CAPACITOR, Disc, .01 µF, 50 V	56289	5C023104X0500B3	100178	3
	C12	CAPACITOR, Dip Mica, 15 pF, 500 V	72136	DM15CD150J0	10024101	1
	C13	Same as C9				
	C14	CAPACITOR, Tant, 4.7 µF, 10 V	56289	150D475X9010A2	100205	1
	C15	CAPACITOR, Dip Mica, 10 pF, 500 V	72136	DM15CD100J0	10025301	2
	C16	Same as C15				
	C17	CAPACITOR, Tant, 15 µF, 20 V	56289	150D156X9020B2	100211	2
	C18	CAPACITOR, Tant, 4.7 µF, 35 V	56289	150D475X9035B2	100071	2
	C19	Same as C11				
	C20	Same as C17				
	C21	Same as C11				
	C22	CAPACITOR, Disc, 1000 pF, 1 kV	91418	TYPE B	100076	1
	C23	Same as C9				
	C24	CAPACITOR, Tant, 2.2 µF, 35 V	56289	150D225X9035B2	100100	1
	C25	CAPACITOR, Disc, .05 µF, 10 V	71590	UK10-503	100122	5
	C26	CAPACITOR, Tant, 47 µF, 20 V	56289	150D476X9020R2	100186	5
	C27	Same as C26				
	C28	Same as C5				
	C29	Same as C5				
	C30	Same as C25				
	C31	Same as C25				
	C32	Same as C26				
	C33	Same as C26				
	C34	Same as C26				
	C35	Same as C5				
	C36	Same as C25				
	C37	Same as C18				
	C38	Same as C25				
	CR1	DIODE, Rectifier, 600 V	04713	1N4005	100413	11
	CR2	Same as CR1				
	CR3	Same as CR1				
	CR4	Same as CR1				
	CR5	Same as CR1				
	CR6	Same as CR1				
	CR7	Same as CR1				
	CR8	Same as CR1				
	CR9	Same as CR1				

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A1, LOGIC ASSEMBLY #05315801 (Cont'd)

ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
	CR10	Same as CR1				
	CR11	NOT USED				
	CR12	Same as CR1				
	CR13	DIODE, Signal, 50 V	03508	1N4151	100385	7
	CR14	Same as CR13				
	CR15	Same as CR13				
	CR16	Same as CR13				
	CR17	Same as CR13				
	CR18	Same as CR13				
	CR19	Same as CR13				
	L1	CHOKE, 100 µH, .216	76493	5250	101328	2
	L2	Same as L1				
	L3	INDUCTOR, Fixed, 470 µH	72259	WEE-WEE-470	101321	1
	Q1	TRANSISTOR, Silicon, NPN	04713	MPS-A42	101421	2
	Q2	Same as Q1				
	Q3	Part of Test Assembly				
	Q4	Part of Test Assembly				
	Q5	TRANSISTOR, Silicon, NPN	07263	2N4275	102716	2
	Q6	TRANSISTOR, Silicon, NPN	07263	2N3646	101369	2
	Q7	TRANSISTOR, Silicon, PNP	07263	2N3640	101357	2
	Q8	TRANSISTOR, unijunction	04713	2N4853	101379	1
	Q9	Same as Q7				
	Q10	Same as Q5				
	Q11	Same as Q6				
	R1	RESISTOR, Comp, 510 k 5%, 1/2 W	01121	EB5145	101534	1
	R2	RESISTOR, Comp, 100 k 5%, 1/4 W	01121	CB1045	101558	1
	R3	RESISTOR, Comp, 10 k 5%, 1/4 W	01121	CB1035	101570	7
	R4	Same as R3				
	R5	RESISTOR, Power, 1 Ω 5%, 2 W	75042	BWH	102214	1
	R6	RESISTOR, Comp, 1 k 5%, 1/4 W	01121	CB1025	101569	4
	R7	RESISTOR, Comp, 3 k 5%, 1/4 W	01121	CB3025	101548	2
	R8	Same as R7				
	R9	RESISTOR, Comp, 4.3 k 5%, 1/4 W	01121	CB4325	101546	2
	R10	RESISTOR, Comp, 9.1 k 5%, 1/4 W	01121	CB9125	101573	1
	R11	Same as R6				
	R12	RESISTOR, Comp, 4.7 k 5%, 1/4 W	01121	CB4725	101598	3
	R13	RESISTOR, Comp, 470 Ω 5%, 1/4 W	01121	CB4715	101625	1
	R14	Same as R3				
	R15	Same as R3				
	R16	RESISTOR, Comp, 1.2 k 5%, 1/4 W	01121	CB1225	101581	1
	R17	Same as R6				
	R18	Same as R3				
	R19	Same as R12				
	R20	RESISTOR, Comp, 8.2 k 5%, 1/4 W	01121	CB8225	101595	1
	R21	RESISTOR, Comp, 47 Ω 5%, 1/4 W	01121	CB4705	101560	1
	R22	Same as R12				
	R23	NOT USED				
	R24	Same as R3				
	R25	RESISTOR, Comp, 3.3 k 5%, 1/4 W	01121	CB3325	101559	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION: A1, LOGIC ASSEMBLY #05315801 (Cont'd)

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
	R26	RESISTOR, Comp, 22 k 5%, 1/4 W	01121	CB2235	101572	8
	R27	Same as R26				
	R28	Same as R26				
	R29	RESISTOR, Comp, 47 k 5%, 1/4 W	01121	CB4735	101574	1
	R30	RESISTOR, Comp, 27 k 5%, 1/4 W	01121	CB2735	101587	2
	R31	Same as R30				
	R32	Same as R3				
	R33	Same as R26				
	R34	Same as R26				
	R35	Same as R26				
	R36	RESISTOR, Comp, 5.6 k 5%, 1/4 W	01121	CB5625	101584	1
	R37	RESISTOR, Comp, 1.5 k 5%, 1/4 W	01121	CB1525	101577	2
	R38	Same as R37				
	R39	Same as R26				
	R40	Same as R26				
	R41	Same as R6				
	R42	Same as R9				
	S1	SWITCH, Pushbutton	52542	053199	053199	1
	U1	Part of Test Assembly				
	U2	INTEGRATED CIRCUIT, Voltage Regulator	27014	LM723CN	025761	1
	U3	INTEGRATED CIRCUIT, Decade Counter, TTL	01295	SN7490N	025732	5
	U4	Same as U3				
	U5	INTEGRATED CIRCUIT, Quad 2-input NAND gates, TTL	01295	SN7400N	019705	5
	U6	INTEGRATED CIRCUIT, Dual 2-W AND-OR-INV gates, TTL	01295	SN7451N	025707	1
	U7	INTEGRATED CIRCUIT, Phase-Frequency Detector, TTL	04713	MC4044P	045238	1
	U8	INTEGRATED CIRCUIT, Dual One-Shot Multivibrator, TTL	01295	SN74123N	045209	4
	U9	INTEGRATED CIRCUIT, Dual D flip-flop, TTL	01295	SN7474N	025241	2
	U10	Same as U5				
	U11	Same as U3				
	U12	Same as U3				
	U13	Same as U3				
	U14	Same as U8				
	U15	Same as U8				
	U16	Same as U8				
	U17	INTEGRATED CIRCUIT, Quad 2-input OR gates, TTL	04713	MC3003P	025767	2
	U18	INTEGRATED CIRCUIT, Quad 2-input AND gates, TTL	04713	MC3001P	025740	3
	U19	Same as U18				
	U20	Same as U5				
	U21	Same as U5				
	U22	INTEGRATED CIRCUIT, 4-2-3-2 AND-OR-INV, gates, TTL	01295	SN74S64N	045222	1
	U23	INTEGRATED CIRCUIT, Quad 2-input NOR gates, TTL	04713	MC3002P	025739	3
	U24	INTEGRATED CIRCUIT, Quad 2-input NAND open, TTL	01295	SN7426N	045252	2
	U25	Same as U9				

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A1, LOGIC ASSEMBLY #05315801 (Cont'd)

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) QTY
	U26	Same as U24				
	U27	Same as U5				
	U28	Same as U18				
	U29	Same as U17				
	U30	Same as U23				
	U31	INTEGRATED CIRCUIT, Counter Timebase Programmable, MOS	50088	MK5009	045214	1
	U32	INTEGRATED CIRCUIT, Dual J-K flip-flop TTL	01295	SN74S112N	025786	1
	U33	INTEGRATED CIRCUIT, Counter/Latch, TTL	01295	SN74196N	025784	1
	U34	INTEGRATED CIRCUIT, BCD-Decimal Decoder	01295	SN7442N	025749	1
	U35	INTEGRATED CIRCUIT, Binary Counter Parallel Set, TTL	18324	N8281A	025727	1
	U36	INTEGRATED CIRCUIT, Timer Wide Range LIN	13324	NE555V	045208	1
	U37	INTEGRATED CIRCUIT, Dec/Store Tri-State TTL	27014	DM85L52N	045212	7
	U38	Same as U37				
	U39	Same as U37				
	U40	Same as U37				
	U41	Same as U37				
	U42	INTEGRATED CIRCUIT, Quad D Regulator Tri-State, TTL	27014	DM85L51N	045210	1
	U43	Same as U37				
	U44	Same as U37				
	U45	Same as U23				
	VR1	DIODE, Zener 180 V	04713	1N9918	100461	1
	XA2	CONNECTOR, 10 position Dual	05574	2VH10/1AV5	101165	2
	XA3	Same as XA2				

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION: A2, READOUT ASSEMBLY #45586-4-1

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
		ASSEMBLY	52542	45586-4-1	45586-4-1	
		SCHEMATIC	52542	45586-7-1	45586-7-1	
	CR1	LED, Red	28480	HPA 5082-4480	100460	5
	CR2	Same as CR1				
	CR3	Same as CR1				
	CR4	Same as CR1				
	CR5	Same as CR1				
	Q1	TRANSISTOR, Silicon, NPN	04713	MPS-A42	101421	8
	Q2	TRANSISTOR, Silicon, PNP	07263	PN4889-18	101422	8
	Q3	Same as Q1				
	Q4	Same as Q2				
	Q5	Same as Q1				
	Q6	Same as Q2				
	Q7	Same as Q1				
	Q8	Same as Q2				
	Q9	Same as Q1				
	Q10	Same as Q2				
	Q11	Same as Q1				
	Q12	Same as Q2				
	Q13	Same as Q1				
	Q14	Same as Q2				
	Q15	Same as Q1				
	Q16	Same as Q2				
	R1	RESISTOR, Comp, 1 k 5%, 1/4 W	01121	CB1025	101569	2
	R2	Same as R1				
	R3	RESISTOR, Comp, 2.2 k 5%, 1/4 W	01121	CB2225	101562	8
	R4	RESISTOR, Comp, 390 k 5%, 1/4 W	01121	CB3945	101787	8
	R5	RESISTOR, Comp, 4.7 k 5%, 1/4 W	01121	CB4725	101598	9
	R6	Same as R3				
	R7	Same as R4				
	R8	Same as R5				
	R9	Same as R3				
	R10	Same as R4				
	R11	Same as R5				
	R12	Same as R3				
	R13	Same as R4				
	R14	Same as R5				
	R15	Same as R3				
	R16	Same as R4				
	R17	Same as R5				
	R18	RESISTOR, Comp, 560 k 5%, 1/4 W	01121	CB5645	101687	3
	R19	RESISTOR, Comp, 1 M 5%, 1/4 W	01121	CB1055	101605	3
	R20	Same as R18				
	R21	Same as R10				
	R22	Same as R5				
	R23	RESISTOR, Comp, 270 Ω 5%, 1/4 W	01121	CB2715	101542	3
	R24	Same as R23				
	R25	Same as R23				

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION: A2, READOUT ASSEMBLY #45586-4-1 (Cont'd)

(1) DESIGNATOR ITEM	(1) DESIGNATOR RFF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
	R26	RESISTOR, Comp, 330 k 5%, 1/4 W	01121	CB3345	101658	14
	R27	Same as R26				
	R28	Same as R26				
	R29	Same as R26				
	R30	Same as R26				
	R31	Same as R3				
	R32	Same as R4				
	R33	Same as R5				
	R34	Same as R3				
	R35	Same as R4				
	R36	Same as R5				
	R37	Same as R18				
	R38	Same as R19				
	R39	Same as R3				
	R40	Same as R4				
	R41	Same as R5				
	R42	Same as R26				
	R43	Same as R26				
	R44	Same as R26				
	R45	Same as R26				
	R46	Same as R26				
	R47	Same as R26				
	R48	Same as R26				
	R49	Same as R26				
	R50	Same as R26				
	U1	INTEGRATED CIRCUIT, Decoder Driver, TTL	01295	SN74141N	025730	1
	U2	INTEGRATED CIRCUIT, BCD 7-Segment Dec/ Driver, TTL	52542	DD700	045203	1
	V1	DISPLAY, 7 Segment, 3 Digit	52542	SP-333	102401	2
	V2	Same as V1				
	V3	DISPLAY, 7 Segment, 2 Digit	52542	SP-332	102400	1
	XV1	SOCKET, Display 3 Digit	52542	CS-333	102443	2
	XV2	Same as XV1				
	XV3	SOCKET, Display 2 Digit	52542	CS-332	102444	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A3, AMPLIFIER ASSEMBLY #05311301

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) QTY
		ASSEMBLY	52542	05311301	05311301	
		SCHEMATIC	52542	7-05311301	7-05311301	
	C1	CAPACITOR, Disc, .01 µF, 100 V	91418	TA110	100103	9
	C2	CAPACITOR, Metmyl, .1 µF, 600 V	99515	D6-104	100158	1
	C3	CAPACITOR, Dip Mica, 10 pF, 500 V	72136	DM15CD100J0	10025301	1
	C4	CAPACITOR, Disc, .1 µF, 10 V	71590	UK10-104	100120	3
	C5	CAPACITOR, Disc, 1 µF, 25 V	56289	5C023105X0250B3	100176	3
	C6	CAPACITOR, Disc, .05 µF, 50 V	56289	TGS50	100134	6
	C7	CAPACITOR, El Ax, 200 µF, 15 V	56289	TE1164	100196	1
	C8	Same as C1				
	C9	CAPACITOR, Disc, 1000 pF, 1 kV	91418	TYPE B	100076	1
	C10	CAPACITOR, Tant, 330 µF, 6 V	56289	150D337X0006S2	100188	2
	C11	Same as C1				
	C12	CAPACITOR, Dip Mica, 47 pF, 500 V	72136	DM15ED470J0	10017101	1
	C13	Same as C6				
	C14	Same as C10				
	C15	Same as C5				
	C16	CAPACITOR, Dip Mica, 22 pF, 500 V	72136	DM15ED220J0	10006801	1
	C17	CAPACITOR, Dip Mica, 5 pF, 500 V	72136	DM15CD050D0	100218	1
	C18	Same as C5				
	C19	Same as C6				
	C20	Same as C6				
	C21	Same as C4				
	C22	Same as C4				
	C23	CAPACITOR, Tant, 15 µF, 20 V	56289	150D156X9020B2	100211	1
	C24	Same as C6				
	C25	Same as C6				
	C26	Same as C1				
	C27	Same as C1				
	C28	Same as C1				
	C29	Same as C1				
	C30	Same as C1				
	C31	Same as C1				
	CR1	DIODE, Signal, 20 V	13715	FD700	100435	2
	CR2	Same as CR1				
	CR3	DIODE, Signal, 20 V	03508	1N4829	100443	2
	CR4	Same as CR3				
	L1	INDUCTOR, Fixed, .33 µH	06560	4416-7K	101324	2
	L2	Same as L1				
	Q1	TRANSISTOR, JFET, N-channel	04713	2N4091	101409	1
	Q2	TRANSISTOR, MOSFET, N-channel Dual Gate	02735	40673	101402	1
	Q3	TRANSISTOR, Silicon, NPN	07263	2N4275	102716	3
	Q4	Same as Q3				
	Q5	Same as Q3				
	Q6	TRANSISTOR, Silicon, NPN	04713	2N3904	101377	1
	R1	RESISTOR, Comp, 22 k 5%, 1/4 W	01121	CB2235	101572	1
	R2	RESISTOR, Potentiometer, 25 k 20%, 1/4 W	52542	/CRL MOD 3/	102113	1
	R3	RESISTOR, Comp, 10 k 5%, 1/4 W	01121	CB1035	101570	3

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION: A3, AMPLIFIER ASSEMBLY #05311301 (Cont'd)

(1) DESIGNATOR ITEM	(1) DESIGNATOR RLF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) Q
	R4	RESISTOR, Comp, 1 M 5%, 1/4 W	01121	CB1055	101605	2
	R5	RESISTOR, Comp, 510 Ω 5%, 1/4 W	01121	CB5115	101616	2
	R6	Same as R4				
	R7	RESISTOR, Potentiometer, Ceramic: 4-turn, 100 k 20%, 1/2 W, end adjust	80294	3339W-1-104	100027	1
	R8	RESISTOR, Comp, 330 k 5%, 1/4 W	01121	CB3345	101658	1
	R9	NOT USED				
	R10	RESISTOR, Comp, 200 Ω 5%, 1/4 W	01121	CB2015	101555	1
	R11	RESISTOR, Comp, 100 k 5%, 1/4 W	01121	CB1045	101558	2
	R12	RESISTOR, Comp, 33 k 5%, 1/4 W	01121	CB3335	101576	1
	R13	RESISTOR, Comp, 270 Ω 5%, 1/4 W	01121	CB2715	101542	1
	R14	RESISTOR, Comp, 100 Ω 5%, 1/4 W	01121	CB1015	101609	1
	R15	RESISTOR, Comp, 1.3 k 5%, 1/4 W	01121	CB1325	101556	1
	R16	Same as R3				
	R17	RESISTOR, Comp, 1.1 k 5%, 1/4 W	01121	CB1125	101589	1
	R18	RESISTOR, Comp, 300 Ω 5%, 1/4 W	01121	CB3015	101537	2
	R19	RESISTOR, Comp, 47 Ω 5%, 1/4 W	01121	CB4705	101560	1
	R20	Same as R11				
	R21	Same as R18				
	R22	RESISTOR, Comp, 51 Ω 5%, 1/4 W	01121	CB5105	101672	2
	R23	RESISTOR, Comp, 680 Ω 5%, 1/4 W	01121	CB6815	101669	1
	R24	Same as R3				
	R25	RESISTOR, Potentiometer, Ceramic: 4-turn, 20 k 20%, 1/2 W, end adjust	80294	3339W-1-203	100028	1
	R26	Same as R22				
	R27	RESISTOR, Comp, 820 Ω 5%, 1/4 W	01121	CB8215	101567	1
	R28	Same as R5				
	R29	RESISTOR, Comp, 1.8 k 5%, 1/4 W	01121	CB1825	101602	1
	R30	RESISTOR, Comp, 1.5 k 5%, 1/4 W	01121	CB1525	101577	1
	TP1	TEST POINT, Brown	91506	8041-1G3	100521	1
	U1	INTEGRATED CIRCUIT, Quad 2-input NAND gates, TTL	01295	SN74S00N	025785	1
	VR1	DIODE, Zener, 6.5 V	13715	FZ902	102736	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A5, OSCILLATOR ASSEMBLY #05318301

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) TQ
		ASSEMBLY	52542	05318301	05318301	
		SCHEMATIC	52542	7-05318301	7-05318301	
	C1	CAPACITOR, Varcer, 9.0-35 pF	72982	538-006D9.0-35	100159	1
	C2	CAPACITOR, Varcer, 15-60 pF	72982	538-011F15-60	100234	1
	C3	CAPACITOR, Dip Mica, 150 pF, 500 V	72136	DM15FD151J0	100219	1
	C4	CAPACITOR, Dip Mica, 100 pF, 500 V	72136	DM15FD101J0	10017301	1
	C5	CAPACITOR, Dip Mica, 220 pF, 500 V	72136	DM15FD221J0	10022001	1
	C6	CAPACITOR, Dip Mica, 33 pF, 500 V	72136	DM15ED330J0	10017501	1
	C7	CAPACITOR, Dip Mica, 10 pF, 500 V	72136	DM15CD100J0	10025301	1
	C8	CAPACITOR, Disc, .01 µF, 100 V	91418	TA110	100103	1
	C9	CAPACITOR, Disc, .05 µF, 10 V	71590	UK10-503	100122	1
	Q1	TRANSISTOR, Silicon, PNP	07263	2N4258	102675	1
	Q2	TRANSISTOR, Silicon, NPN	07263	2N4275	102716	2
	Q3	Same as Q2				
	R1	RESISTOR, Comp, 47 k 5%, 1/4 W	01121	CB4735	101574	1
	R2	RESISTOR, Comp, 100 k 5%, 1/4 W	01121	CB1045	101558	1
	R3	RESISTOR, Comp, 4.7 k 5%, 1/4 W	01121	CB4725	101598	1
	R4	RESISTOR, Comp, 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R5	RESISTOR, Comp, 1 k 5%, 1/4 W	01121	CB1025	101569	1
	R6	RESISTOR, Comp, 3.3 k 5%, 1/4 W	01121	CB3325	101559	1
	R7	RESISTOR, Comp, 470 Ω 5%, 1/4 W	01121	CB4715	101625	1
	Y1	CRYSTAL	52542	039483	039483	1

CHAPTER 8
STANDARD OPTIONS

8.1 INTRODUCTION

Included in this chapter are standard options for the Model 6220A Frequency Counter, listed by numerical sequence. Special modifications ordered by the customer may also be included in this chapter. Page numbering consists of the option number followed by the numbered page of the option; i.e.: Option 10, page 5, will be numbered OPT 10-5.

TABLE 8.1 OPTION INDEX INFORMATION

Ref.	Description	Dwg #	Page #
OPT 06	Internal Battery Operation	053523	OPT 06/
OPT 07	External Battery Operation	053512	OPT 07-1
OPT 08	Oscillator Temperature Stability	053411	OPT 08-1
OPT 09	Oscillator Temperature Stability	053585	OPT 09-1
OPT 11	Oscillator Aging Rate	053513	OPT 11/
OPT 12	Oscillator Aging Rate	053513	OPT 12/
OPT 13	Oscillator Aging Rate	053513	OPT 13-1
---	Rack Mounting	4541003	ACCESSORY-1

CIRCUIT DESCRIPTION
OPTION 06 AND OPTION 07
FINAL ASSEMBLY #053523/#053512

DESCRIPTION

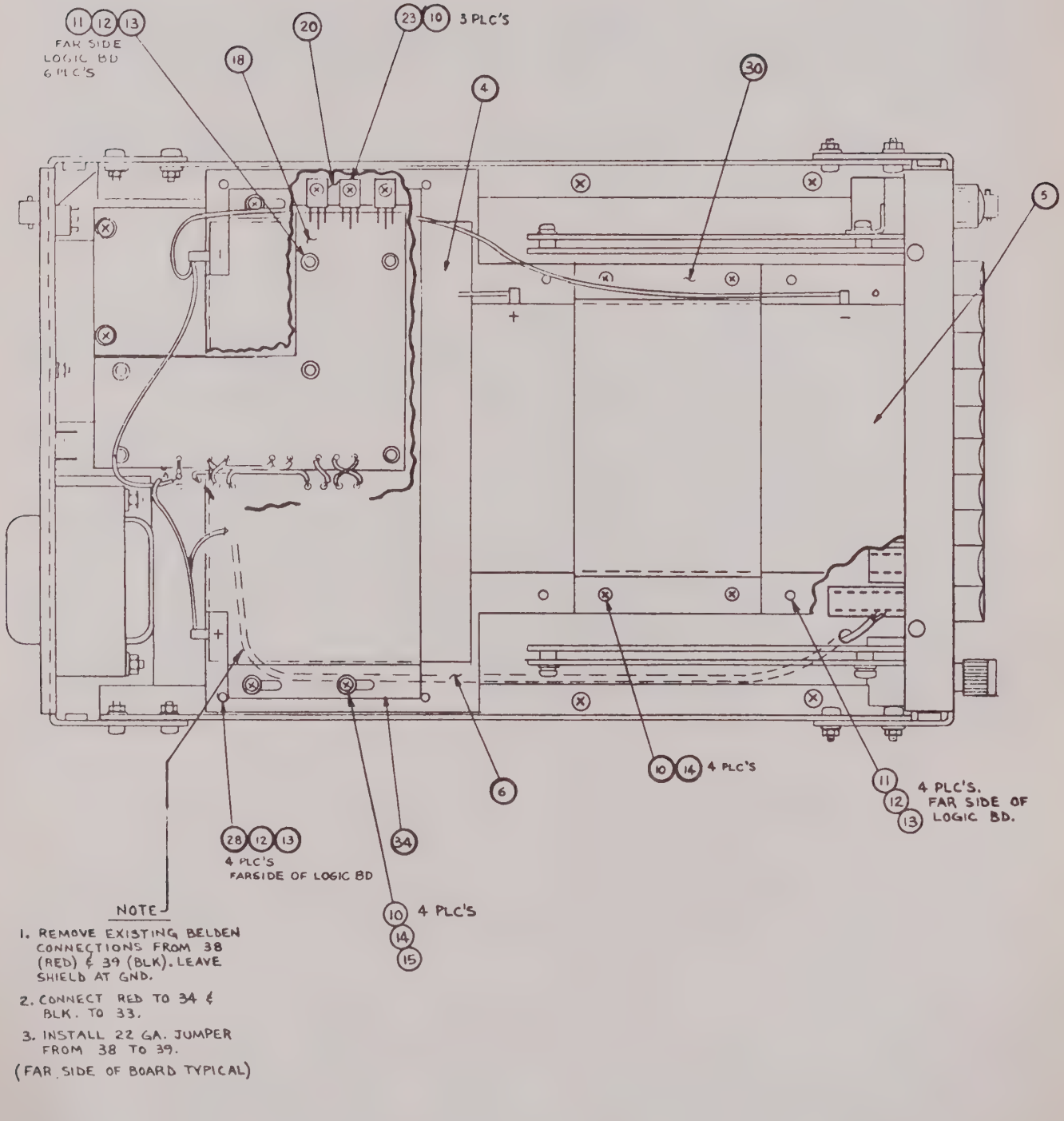
Option 06 provides independent portable operation of approximately three hours from an internal battery pack. An internal battery charger and power inverter circuitry are included in the package.

Option 07 provides portable operation of the Model 6220A with the use of an external battery or 5.5 V to 12 V dc power source. External, banana type, jacks are provided for external connections and power inverter circuitry is provided.

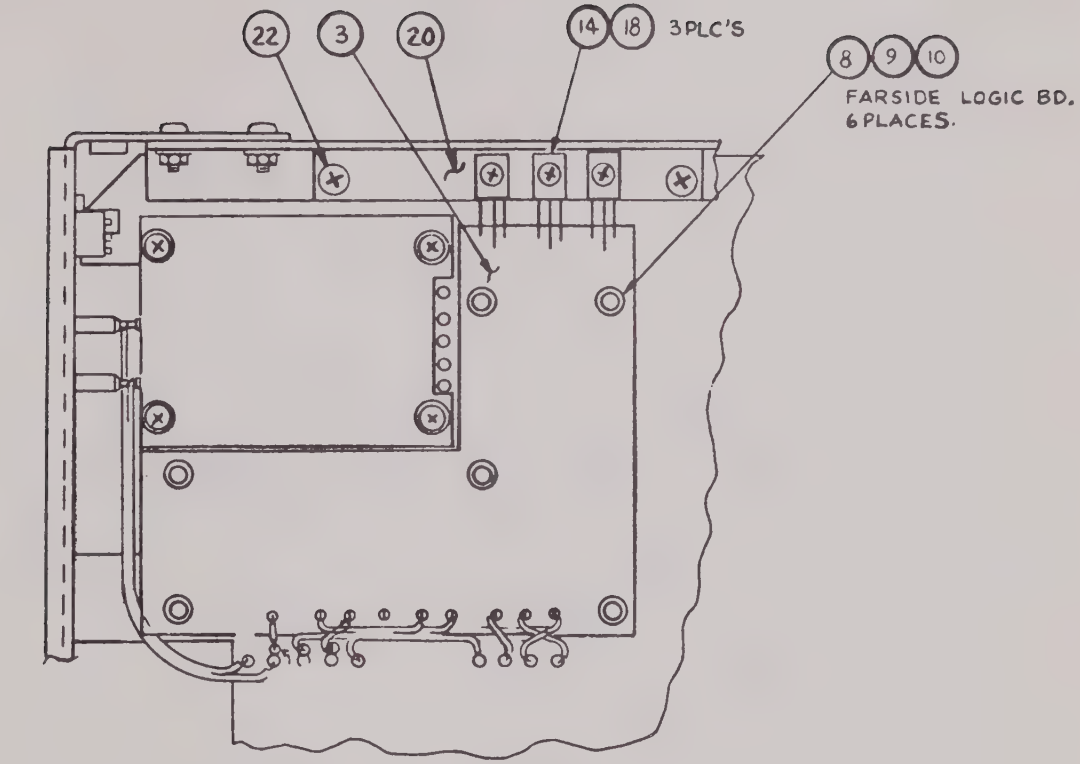
CIRCUIT DESCRIPTION (Schematic #7-05317501)

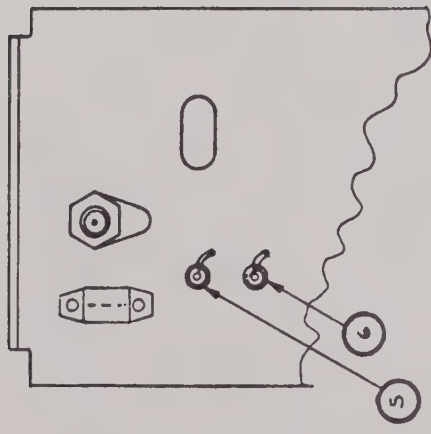
Power Inverter Assembly, A7, is provided with Option 06 or Option 07. With Option 06 installed, the POWER switch in the OFF position, and the instrument connected to the line voltage, battery charging is provided through Q8, Q2, Q9, Q10, and associated circuitry.

There are two identical independent +5 V dc regulating circuits and a power inverter, U1, which supplies -18 V dc and +180 V dc. The +5 V dc regulators consist of Q1, Q4, Q5, U2, VR2, and Q3, Q6, Q7, U2, and VR3 respectively, and the resistance/capacitance circuitry associated with each. One supplies +5 V dc to the instrument and the other to the power inverter, U1. Operational amplifier, U2, controls the input to the base of Q4 and the collector of Q4 is directly coupled to the base of pass transistor Q1. The output of Q1 is adjustable with potentiometer R15. Q5 is held off for battery operation and shorts the output of U2 when the instrument is connected to line voltage for operation. The other +5 V regulator operates in a like manner.

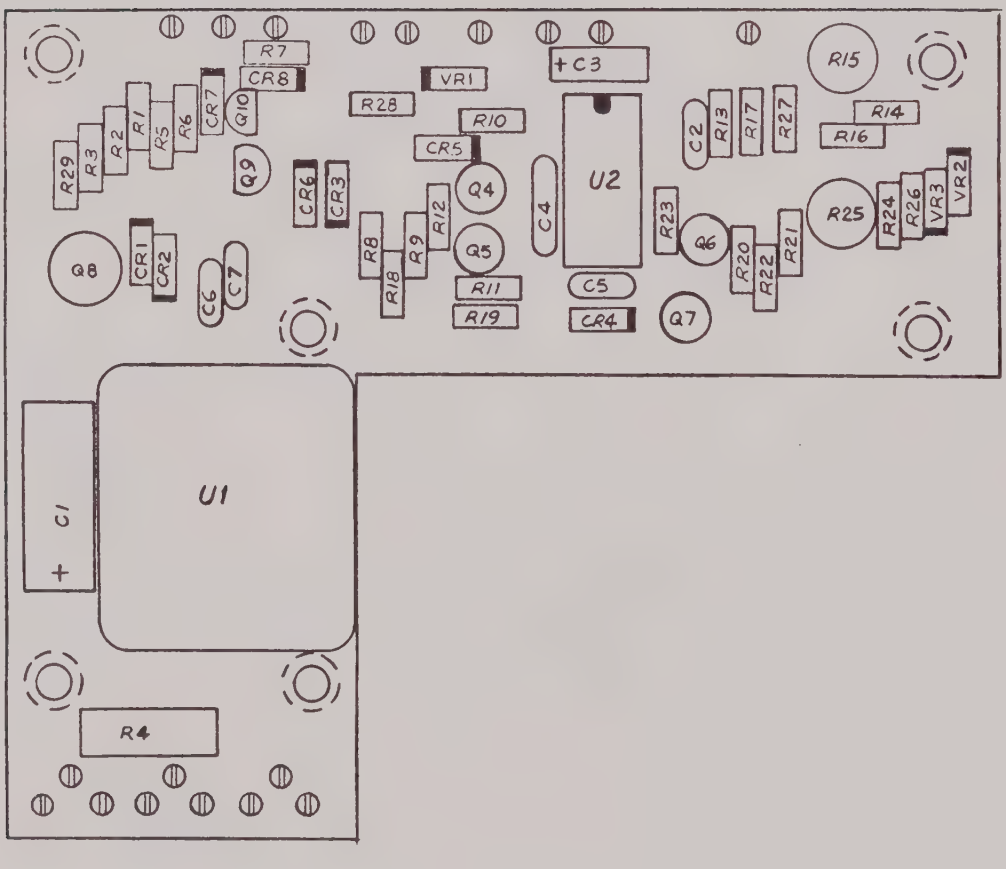


FINAL ASSEMBLY OPTION 06 #053523 REV C

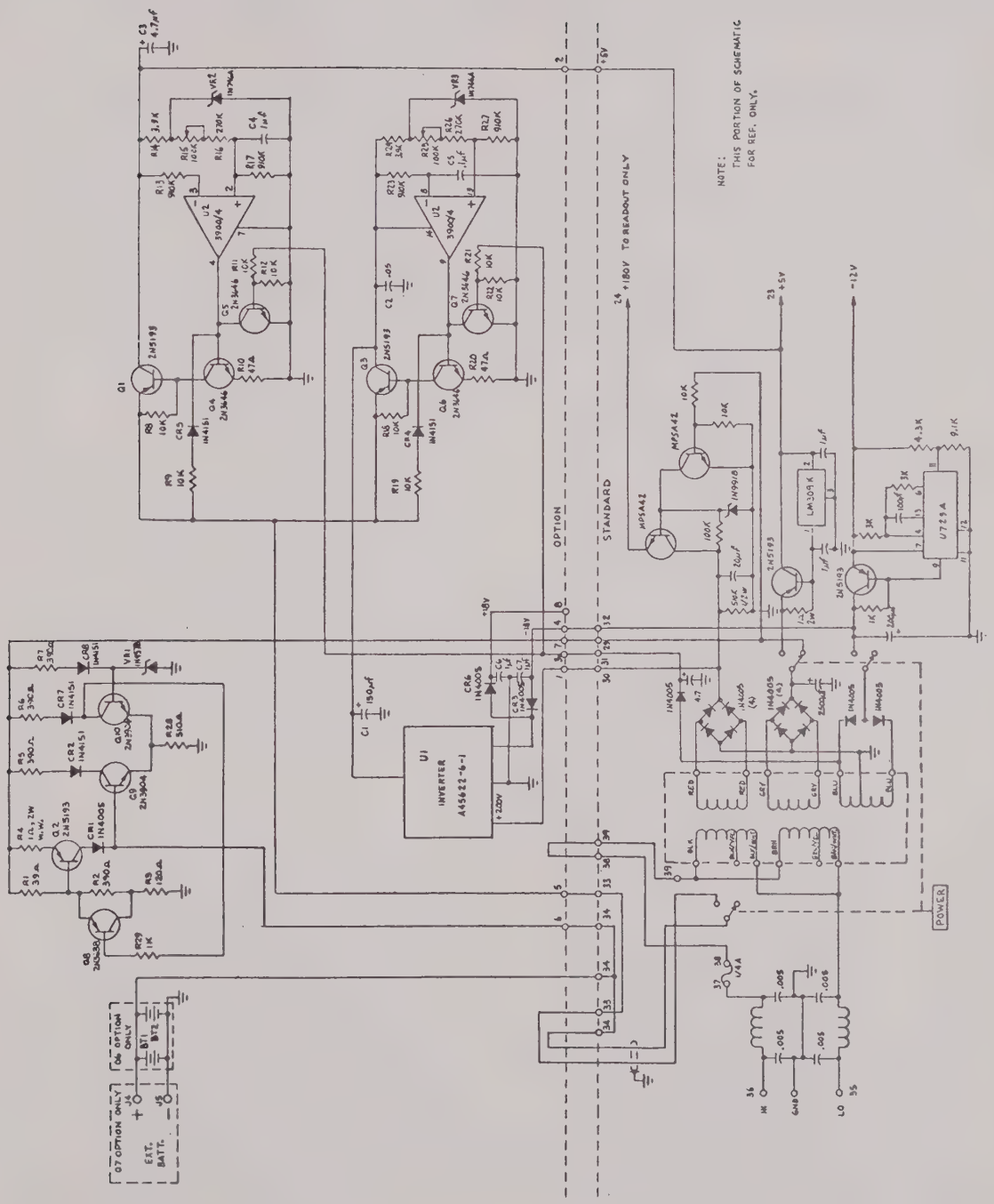




FINAL ASSEMBLY OPTION 07 #053512 REV A



POWER INVERTER ASSEMBLY #05317501 REV C



POWER INVERTER SCHEMATIC #7-05317501 REV C

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION: FINAL ASSEMBLY OPTION 06 AND 07

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
		OPTION 06 #053523				
		ASSEMBLY	52542	053523	053523	
		SCHEMATIC	52542	7-05317501	7-05317501	
		CHASSIS, Battery	52542	053176	053176	1
		KIT, OPT. 06 Battery Pack	52542	05352391	05352391	
	BT1	BATTERY, 6 V	25244	GC645-1	100042	2
	BT2	Same as BT1				
		ASSEMBLY, Front Battery Clamp	52542	04561401	04561401	1
		CLAMP, Battery	52542	045614	045614	1
		ASSEMBLY, Rear Battery Clamp	52542	04161501	04161501	1
		CLAMP, Battery	52542	045615	045615	1
		OPTION 07 #053512				
		ASSEMBLY	52542	053512	053512	
		SCHEMATIC	52542	7-05317501	7-05317501	
		ASSEMBLY, Power Inverter	52542	05317501	05317501	1
	J4	BANANAJACK, Red	74970	108-1102-001	101275	1
	J5	BANANAJACK, Black	74970	108-1103-001	101276	1
	Q1	TRANSISTOR, Silicon, PNP	04713	2N5193	101405	3
	Q2	Same as Q1				
	Q3	Same as Q1				
		HEATSINK, Right	52542	053188	053188	1
		POWER INVERTER ASSEMBLY OPTION 06-07 #05317501				
		ASSEMBLY	52542	05317501	05317501	
		SCHEMATIC	52542	7-05317501	05317501	
	C1	CAPACITOR, Tant, 150 µF, 15 V	56289	150D157X9015S	100209	1
	C2	CAPACITOR, Disc, .05 µF, 10 V	71590	UK10-503	100122	1
	C3	CAPACITOR, Tant, 4.7 µF, 10 V	56289	150D475X9010A2	100205	1
	C4	CAPACITOR, Disc, 1 µF, 25 V	56289	5C023105X0250B3	100176	3
	C5	CAPACITOR, Disc, .1 µF, 10 V	71590	UK10-104	100120	1
	CR1	DIODE, Rectifier, 600 V	04713	1N4005	100413	3
	CR2	DIODE, Signal, 50 V	03508	1N4151	100385	5
	CR3	Same as CR1				
	CR4	Same as CR2				
	CR5	Same as CR1				
	CR6	Same as CR2				
	CR7	Same as CR2				
	CR8	Same as CR2				

EQUIPMENT/ASSEMBLY DESIGNATION FINAL ASSEMBLY OPTION 06 AND 07 (Cont'd)

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
		POWER INVERTER ASSEMBLY OPTION 06-07 #05317601 (Cont'd)				
	Q1	Part of Final Assembly				
	Q2	Part of Final Assembly				
	Q3	Part of Final Assembly				
	Q4	TRANSISTOR, Silicon, NPN	07263	2N3646	101369	4
	Q5	Same as Q4				
	Q6	Same as Q4				
	Q7	Same as Q4				
	Q8	TRANSISTOR, Silicon, PNP	07263	2N3638	101360	1
	Q9	TRANSISTOR, Silicon, NPN	04713	2N3904	101377	2
	Q10	Same as Q9				
	R1	RESISTOR, Comp, 39 Ω 5%, 1/4 W	01121	CB3905	101733	1
	R2	RESISTOR, Comp, 390 Ω 5%, 1/4 W	01121	CB3915	101592	4
	R3	RESISTOR, Comp, 120 Ω 5%, 1/4 W	01121	CB1215	101717	1
	R4	RESISTOR, Power, 1 Ω 5%, 2 W	75042	BWH	102214	1
	R5	Same as R2				
	R6	Same as R2				
	R7	Same as R2				
	R8	RESISTOR, Comp, 10 k 5%, 1/4 W	01121	CB1035	101570	8
	R9	Same as R8				
	R10	RESISTOR, Comp, 47 Ω 5%, 1/4 W	01121	CB4705	101560	2
	R11	Same as R8				
	R12	Same as R8				
	R13	RESISTOR, Comp, 910 k 5%, 1/4 W	01121	CB9145	101885	4
	R14	RESISTOR, Comp, 3.9 k 5%, 1/4 W	01121	CB3925	101601	2
	R15	RESISTOR, Potentiometer, Ceramic: 4-turn, 100 k 20%, 1/2 W, top adjust	80294	3339H-1-104	102298	2
	R16	RESISTOR, Comp, 270 k 5%, 1/4 W	01121	CB2745	101769	2
	R17	Same as R13				
	R18	Same as R8				
	R19	Same as R8				
	R20	Same as R10				
	R21	Same as R8				
	R22	Same as R8				
	R23	Same as R13				
	R24	Same as R14				
	R25	Same as R15				
	R26	Same as R16				
	R27	Same as R13				
	R28	RESISTOR, Comp 510 Ω 5%, 1/4 W	01121	CB5115	101616	1
	R29	RESISTOR, Comp, 1 k 5%, 1/4 W	01121	CB1025	101569	1
	U1	INVERTER, 5 VDC	52542	04562261	04562261	1
	U2	INTEGRATED CIRCUIT, Operation Amplifier	27014	LM3900N	045213	1
	VR1	DIODE, Zener, 6.8 V	04713	1N957B	100416	1
	VR2	DIODE, Zener, 3.3 V	03877	1N746A	100415	2
	VR3	Same as VR2				

CIRCUIT DESCRIPTION
OPTION 08
OSCILLATOR ASSEMBLY #053411

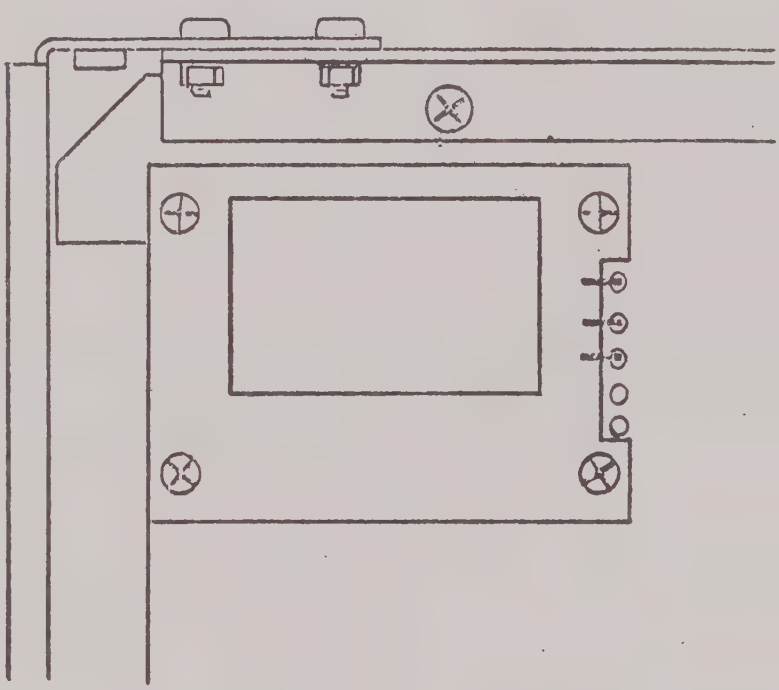
SPECIFICATIONS

Aging Rate:	$<\pm 3$ parts in 10^7/month
Temperature Stability:	± 1 part in 10^6 from 0 to 50°C
Line Voltage:	$<\pm 1$ part in 10^7 for 10% line variation
External input:	1 MHz at 1 volt rms into 1 kΩ

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION: OPTION 08 FINAL ASSEMBLY #053411

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
		ADD				
	A5	ASSEMBLY, Oscillator TCXO	52542	0538401	0538401	1
		DELETE				
	A5	ASSEMBLY, Oscillator Standard	52542	05318301	05318301	1



NOTES:

1. REMOVE STD. OSC. P.C. ASS'Y. AND DISCONNECT (5) JUMPERS.
2. INSTALL (3) 24 GA. JUMPERS TO 05318401 ASS'Y. AND MOUNT AS SHOWN ABOVE
3. THE EXISTING WHT-RED-GRN WIRE ON THE GND. LUG REMAINS.

OPTION 08 ASSEMBLY #053411 REV A

CIRCUIT DESCRIPTION
OPTION 09
OSCILLATOR ASSEMBLY #053585

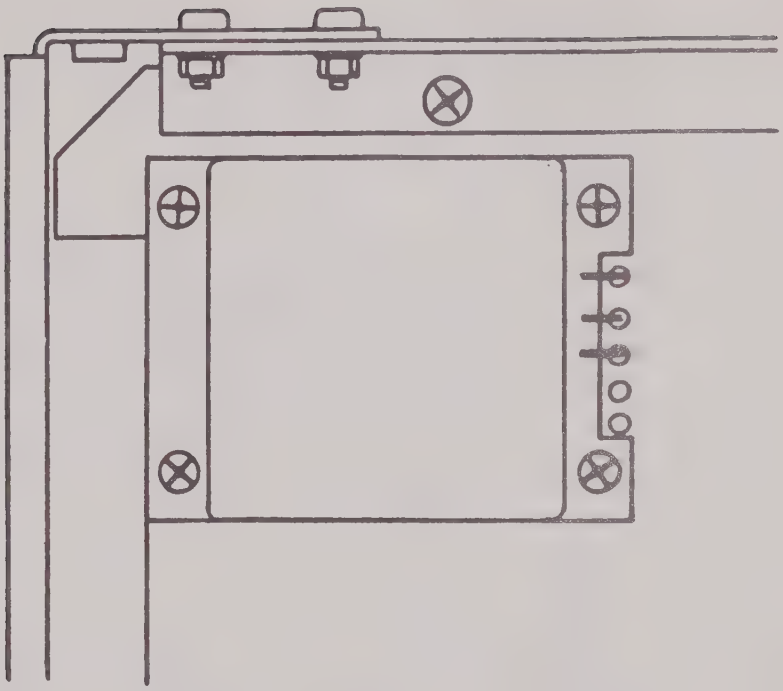
SPECIFICATIONS

Aging Rate	
Long term:	<±3 parts in 10^7/month
Short term:	±1 part in 10^8/day; 3 day average
Temperature Stability:	TCXO. ±1 part in 10^7 over 0° to 50°C
Line voltage:	±1 part in 10^8 for 10% line variation
External input:	1 MHz at 1 V rms into 1 kΩ

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION: OPTION 09 FINAL ASSEMBLY #053585

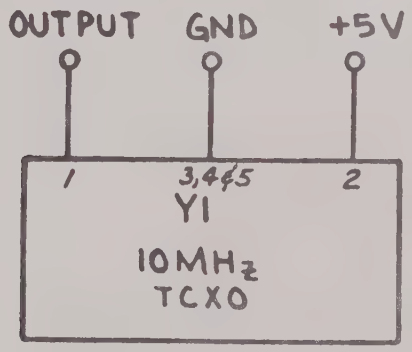
(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/C
		ADD				
	A5	ASSEMBLY, Oscillator TCXO	52542	05318402	05318402	1
		DELETE				
	A5	ASSEMBLY, Oscillator Standard	52542	05318301	05318301	1



NOTES:

1. REMOVE STD. OSC. P.C. ASS'Y. AND DISCONNECT (5) JUMPERS.
2. INSTALL (3) 24 GA. JUMPERS TO 05318402 ASS'Y. AND MOUNT AS SHOWN ABOVE
3. THE EXISTING WHT-RED-GRN WIRE ON THE GND. LUG REMAINS.

OPTION 09 TCXO OSCILLATOR ASSEMBLY #053585 REV A



OPTION 09 TCXO OSCILLATOR SCHEMATIC #7-05318402 REV A

CIRCUIT DESCRIPTION
OSCILLATOR OPTION 11, 12, 13
FINAL ASSEMBLY #053513

DESCRIPTION

These Oscillator Options provide higher stability than the standard oscillator. The added assemblies include: U2, 3 MHz Oscillator and A7, Oscillator Control Assembly.

SPECIFICATIONS, OPTION 11

Frequency:	3 MHz
Aging rate after warm-up:	±3 parts in 10^9 per day
Maximum warm-up for "OFF" periods to one week:	72 hours
Frequency retrace for "OFF" periods to 24 hours:	1 hour to reach 6 X 10^8 maximum
Short term aging rate:	±2 X 10^{10} rms, 1 second
Temperature Stability:	<±2 parts in 10^{10}/C° typical ±4 parts in 10^9 over 20°C from 0° to 50°C maximum
Voltage Stability:	28 V ±1 V; ±5 X 10^{10} maximum

SPECIFICATIONS, OPTION 12

Frequency:	3 MHz
Aging rate after warm-up:	±1 part in 10^9 per day
Maximum warm-up for "OFF" periods to 1 week:	72 hours
Frequency retrace for "OFF" periods to 24 hours:	1 hour to reach ±6 X 10^8 maximum
Short term aging rate:	1 X 10^{10} rms, 1 second
Temperature Stability:	<±2 parts in 10^{10}/C° typical
Voltage Stability:	28 V ±2 V; ±5 X 10^{10} maximum

SPECIFICATIONS, OPTION 13

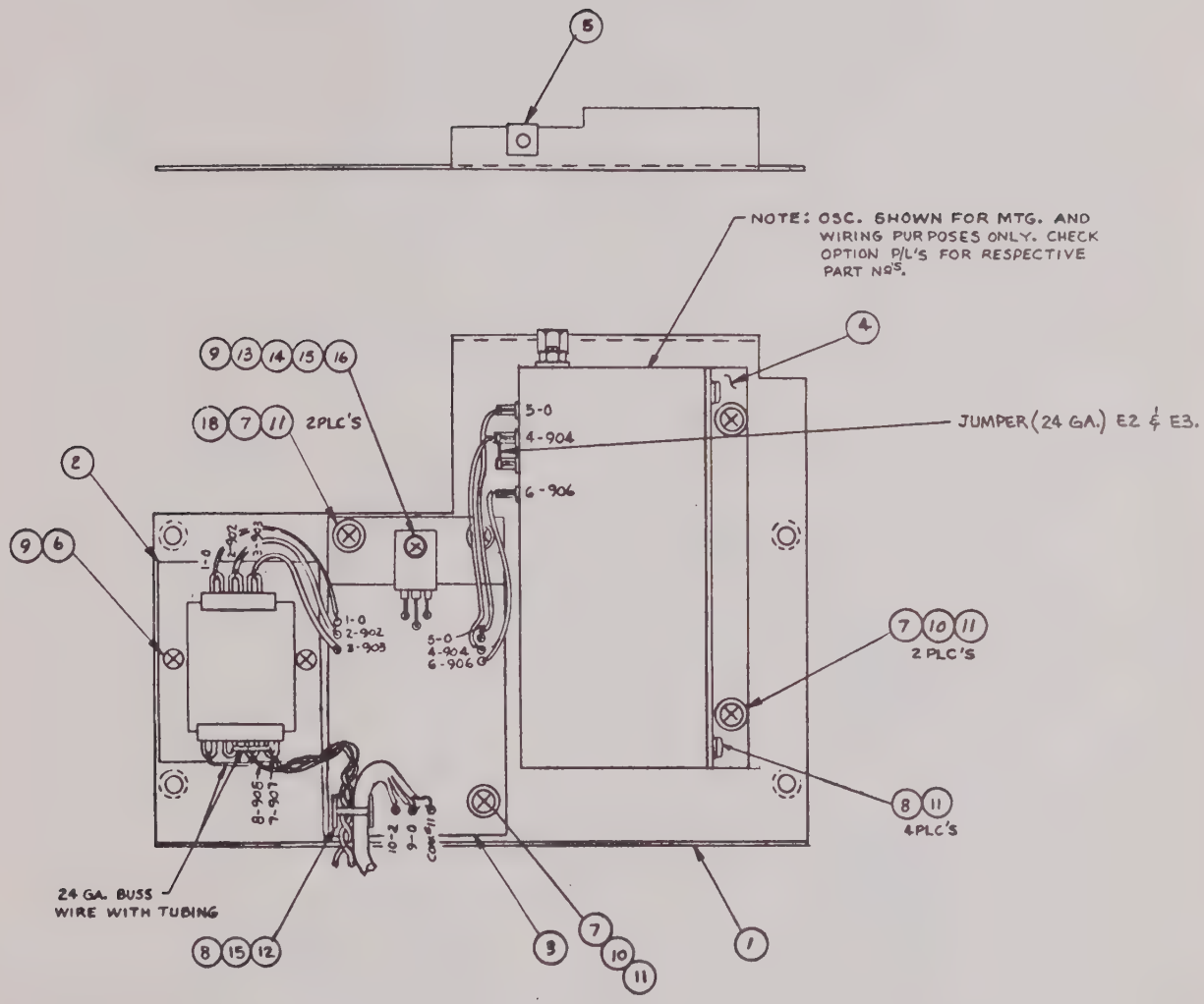
Frequency:	3 MHz
Aging rate after warm-up:	±5 parts in 10^{10} per day
Maximum warm-up for "OFF" periods to 1 week:	72 hours

SPECIFICATIONS, OPTION 13 (Cont'd)

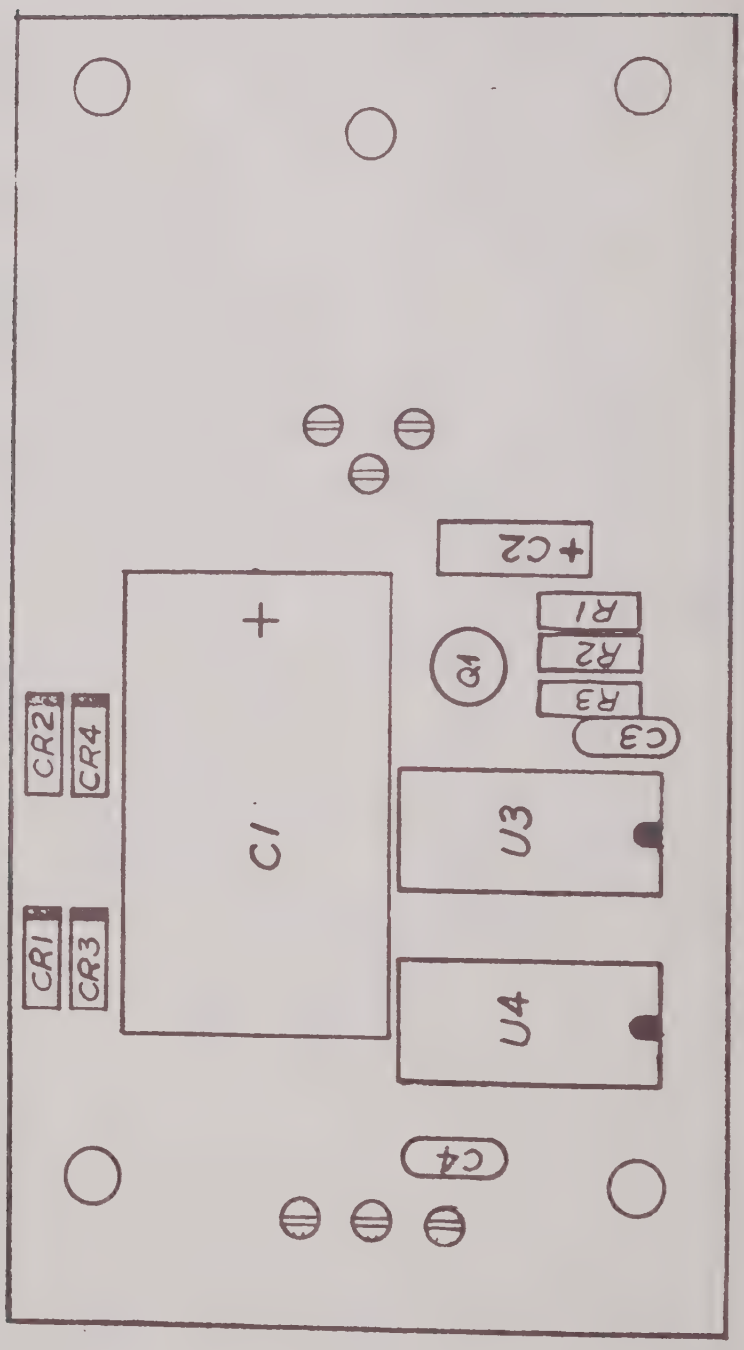
Frequency retrace for "OFF" periods to 24 hours:	1 hour typical to reach 5 X 10^{9} of turnoff frequency
Short term aging rate:	5 X 10^{11} rms, 1 second
Temperature Stability:	<±5 parts in 10^{11}/C° typical
Voltage Stability:	28 V ±2 V; ±5 X 10^{10} maximum

CIRCUIT DESCRIPTION (Schematic #7-05318501)

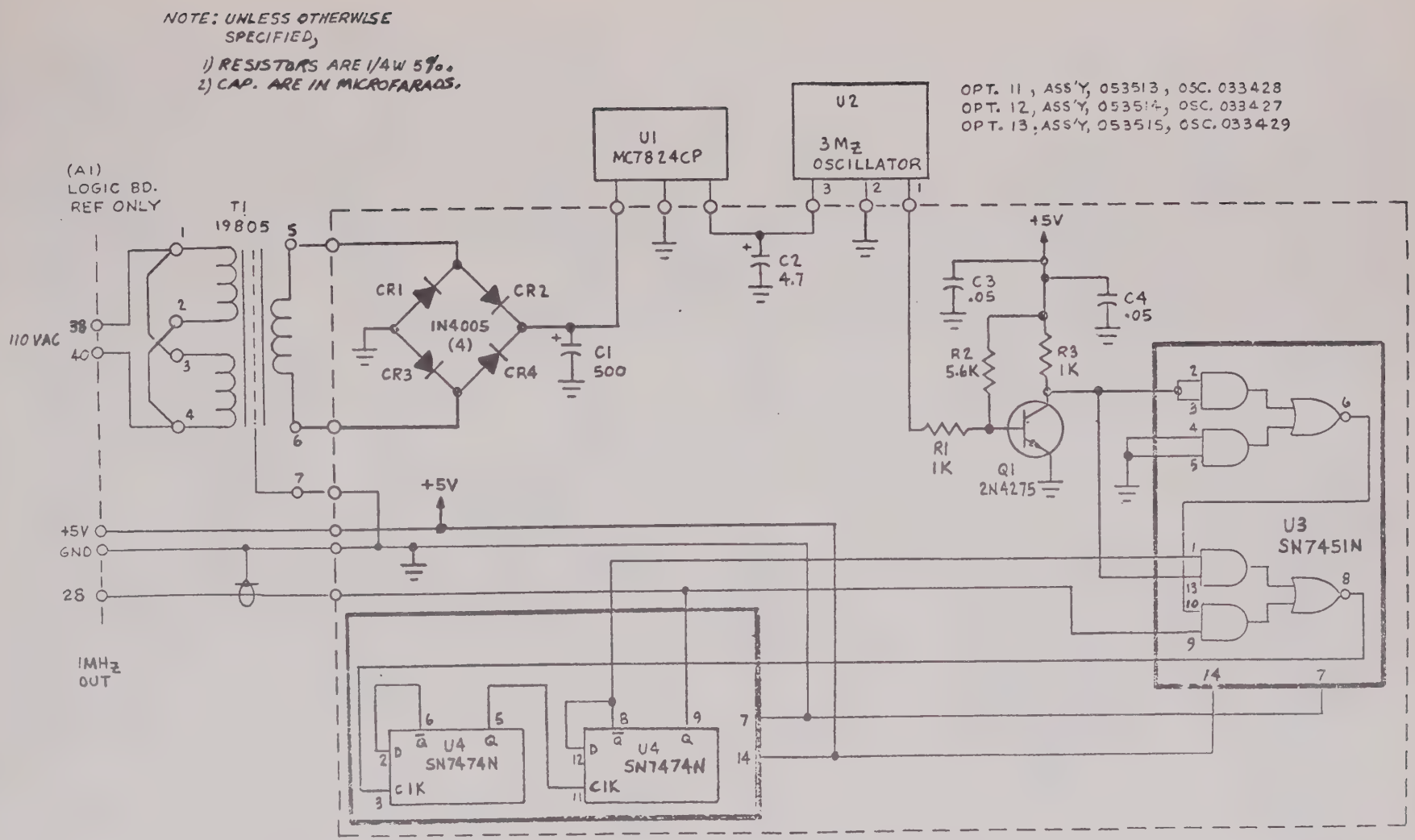
When the instrument power cord is plugged into line voltage, the bridge rectifier provides power to the crystal oven through the 28 V dc regulator, U1. The 3 MHz output of U2 is fed through amplifier Q1 to the dual AND/OR gate U3. The output of U3-8 is fed to U4-3 as a clock signal. U4 is a dual D flip-flop divide-by-three circuit. The 1 MHz output is coupled through A1U5, bypassing A1U3, the divide-by-ten circuit which counts the standard 10 MHz down to 1 MHz.



OSCILLATOR CHASSIS ASSEMBLY #05321501 REV A

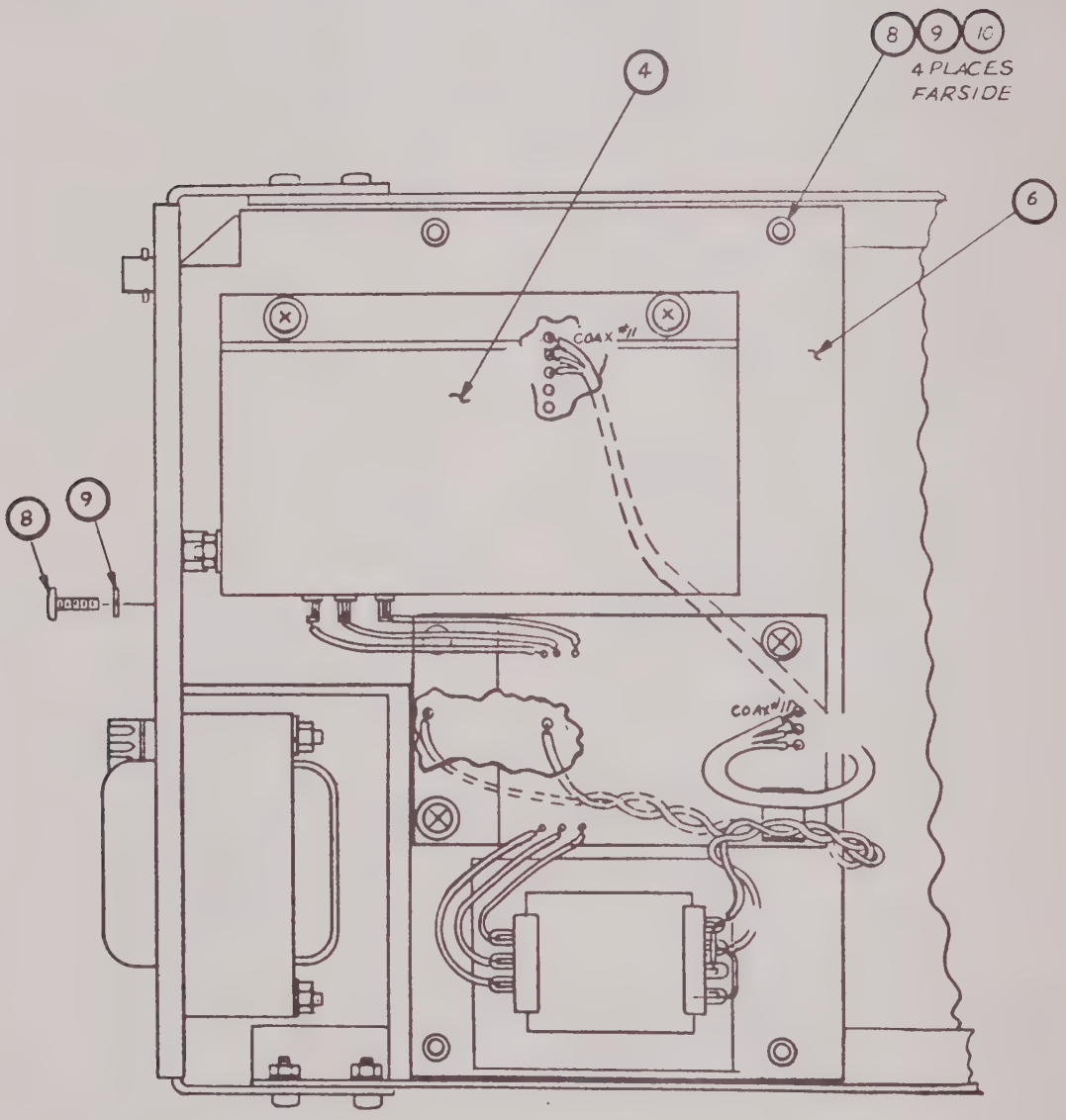


A7, OSCILLATOR CONTROL ASSEMBLY #05318501 REV A



A7, OSCILLATOR CONTROL SCHEMATIC #7-05318501 REV A

NOTES: UNLESS OTHERWISE SPECIFIED,
1. SOLDER WIRES TO LOGIC BOARD(A1), BEFORE MOUNTING DOWN CHASSIS ITEM 6.



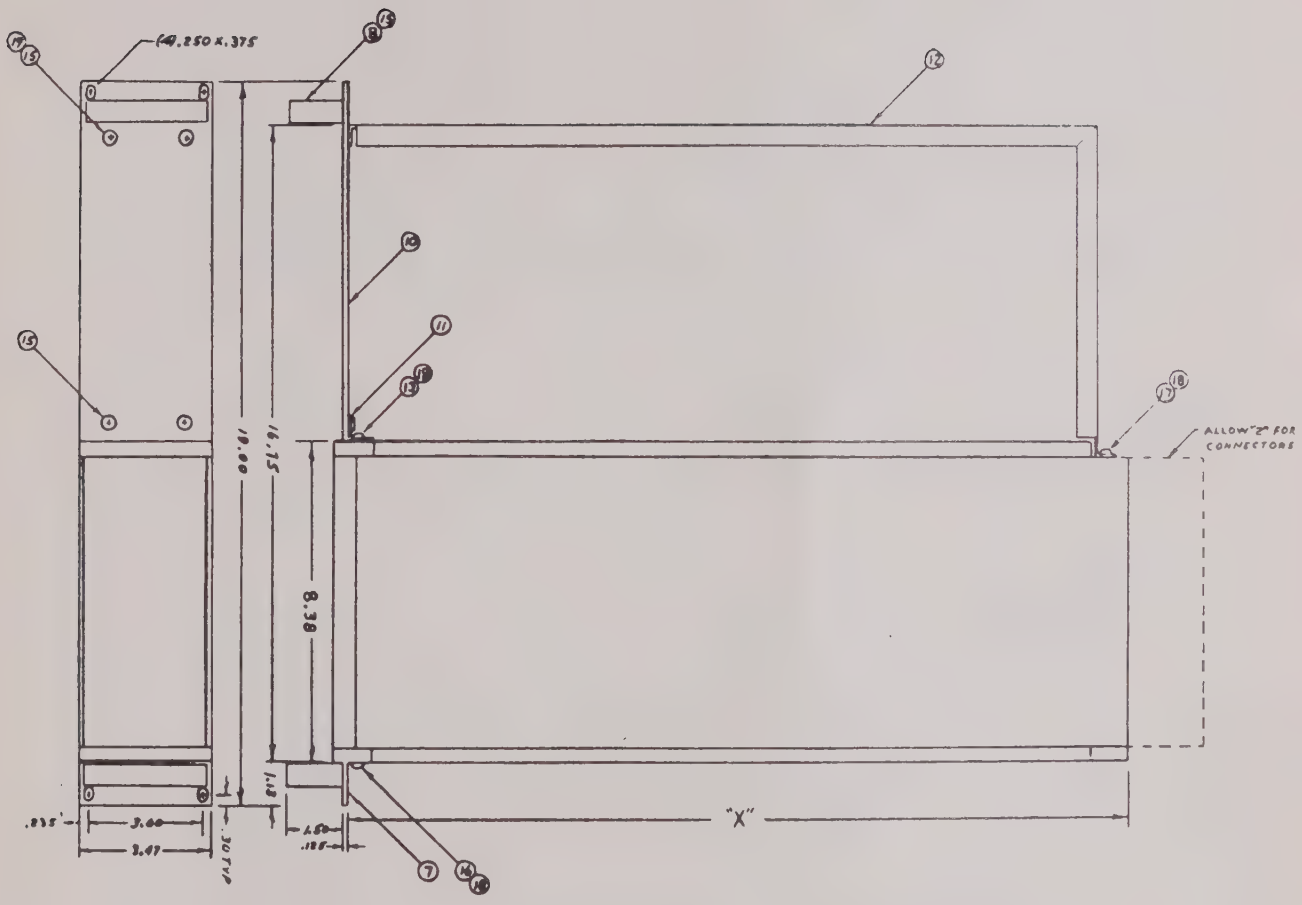
OPTION	FINAL P/L
11	053513
12	053514
13	053515

OSCILLATOR OPTION FINAL ASSEMBLY #053513 REV A

REPLACEABLE PARTS LIST

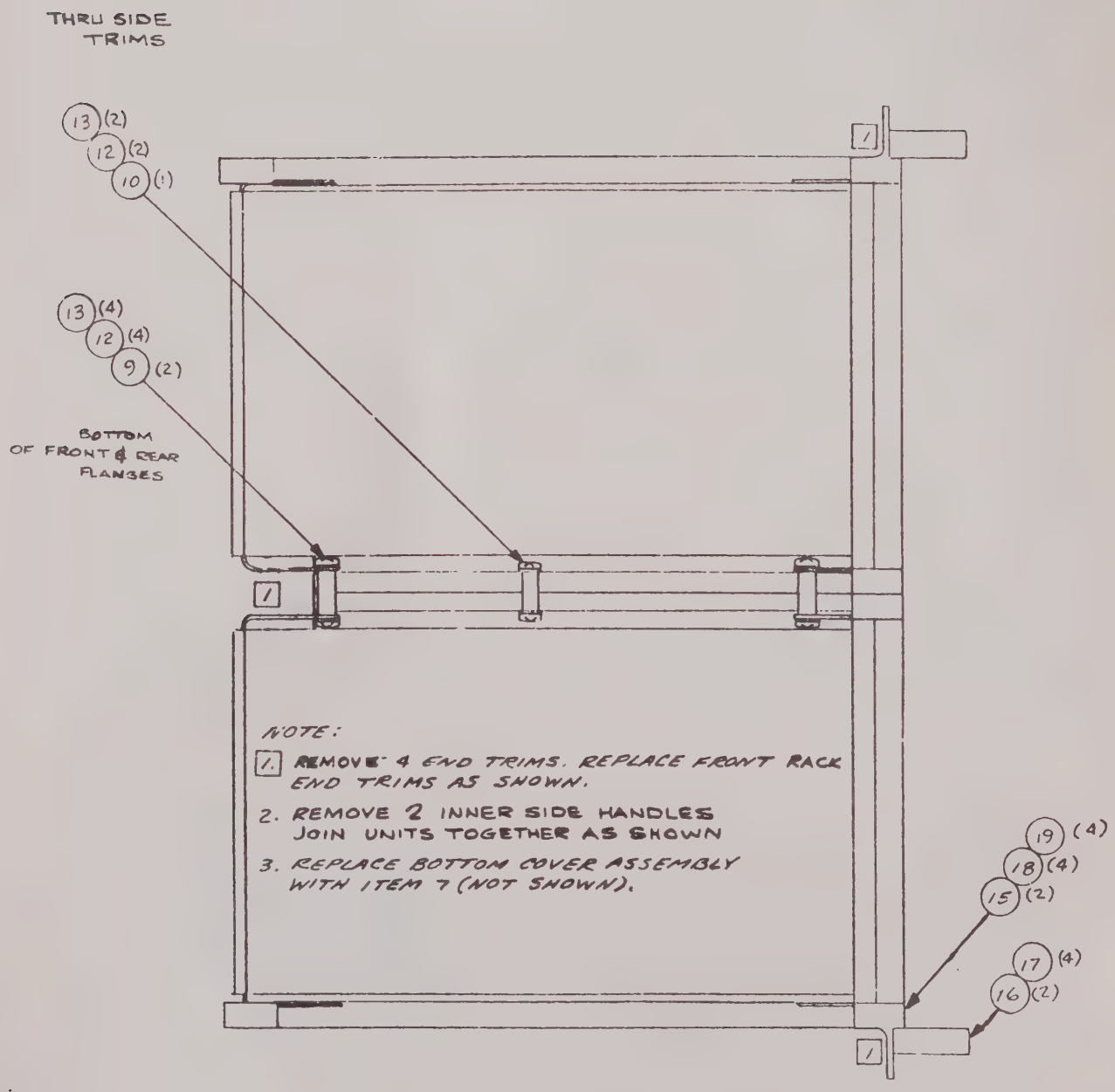
EQUIPMENT/ASSEMBLY DESIGNATION: FINAL ASSEMBLY OPTION 11, 12, & 13

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
		CHASSIS ASSEMBLY #05321501				
		CHASSIS, Oscillator	52542	053177	053177	1
		TRANSFORMER, Power	52542	019805	019805	1
		BRACKET, Mounting B3 Oscillator	52542	039044	039044	1
	U1	INTEGRATED CIRCUIT, Voltage Regulator	07263	UGH7824393	045246	1
		ASSEMBLY, Oscillator Control	52542	05318501	05318501	1
		consisting of the following:				
	C1	CAPACITOR, El Ax, 500 µF, 50 V	00853	052HJ501X050B	100296	1
	C2	CAPACITOR, Tant, 4.7 µF, 35 V	56289	150D475X9035B2	100071	1
	C3	CAPACITOR, Disc, .05 µF, 10 V	71590	UK10-503	100122	2
	C4	Same as C3				
	CR1	DIODE, Rectifier, 600 V	04713	1N4005	100413	4
	CR2	Same as CR1				
	CR3	Same as CR1				
	CR4	Same as CR1				
	Q1	TRANSISTOR, Silicon, NPN	07263	2N4275	102716	1
	R1	RESISTOR, Comp, 1 k 5%, 1/4 W	01121	CB1025	101569	2
	R2	RESISTOR, Comp, 5.6 k 5%, 1/4 W	01121	CB5625	101584	1
	R3	Same as R1				
	U1	Part of Chassis Assembly				
	U2	Part of Final Assembly				
	U3	INTEGRATED CIRCUIT, Dual 2-W AND-OR-INV, TTL	01295	SN7451N	025707	1
	U4	INTEGRATED CIRCUIT, Dual D flip-flop TTL	01295	SN7474N	025241	1
		OPTION 11 #053513				
		ASSEMBLY	52542	053513	053513	
		SCHEMATIC	52542	7-053185	7-053185	
	U2	OSCILLATOR, 3 MHz OPT 11	52542	033428	033428	1
		OPTION 12 #053514				
		ASSEMBLY	52542	053514	053514	
		SCHEMATIC	52542	7-053185	7-053185	
	U2	OSCILLATOR, B OPTION HIGH STABILITY OPT 12	52542	033427	033427	1
		OPTION 13 #053515				
		ASSEMBLY	52542	053515	053515	
		SCHEMATIC	52542	7-053185	7-053185	
	U2	OSCILLATOR, 3 MHz OPT 13	52542	033429	033429	1



TABULATION		
P/L #	"X"	INSTR. DEPTH
45410-1	8.75	9.12
45410-2	10.75	11.12
45410-3	12.75	13.12
45410-4	14.75	15.12
45410-5	16.75	17.12
45410-6	18.75	19.12
45410-7	20.75	21.12

3 1/2" HALF RACK ASSEMBLY #045410 REV A



DUAL RACK MOUNT ASSEMBLY #032492-3 REV A

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION RACK MOUNT ASSEMBLY

(1) DESIGNATOR ITEM	(1) DESIGNATOR RLF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
		3 1/2" HALF RACK ASSEMBLY #4541003				
		ADD				
		TRIM, End Rack Mount	52542	045476-2	045476-2	1
		HANDLE	06450	11351-A-0832-2	100927	2
		PANEL, Rack Mount	52542	039953-2	039953-2	1
		PANEL, Rack Mount Adapter	52542	039954-2	039954-2	1
		ADAPTER, Chassis	52542	045411-3	045411-3	1
		* *				
		DELETE				
		TRIM, End	52542	033693	033693	2
		HANDLE	52542	033570-3	033570-3	2
		ASSEMBLY, Bail & Foot	21604	MP40008-1	100971	1
		DUAL RACK MOUNT ASSEMBLY #37492-3				
		ADD				
		COVER, Bottom	52542	053050-3	053050-3	1
		TRIM, End Rack Mount	52542	045476-2	045476-2	2
		HANDLE	06540	11351-A-0832-2	100927	2
		* *				
		DELETE				
		COVER, Bottom	52542	045065-3	045065-3	2
		TRIM, End	52542	039033	039033	4
		HANDLE	52542	033570-3	033570-3	4

CHAPTER 9
SUPPLEMENTAL INFORMATION

9.1 INTRODUCTION

This chapter contains revised or updated information reflecting changes in production requirements of this instrument. This information can include changes in assembly/schematic drawings, parts lists, operating instructions, calibration procedures, etc. Changes to parts lists will contain only the added parts, plus a list of deleted items. The supplemental pages for each assembly will be identified with the words SUPPLEMENTAL INFORMATION, followed by the nomenclature of the board. For example, if the Logic Assembly is to be changed, the package identification will read as follows:

SUPPLEMENTAL INFORMATION
A1, LOGIC ASSEMBLY
SCHEMATIC #7-05315801

Page identification for an October 19XX change will be:

6251-10-XX SUPPLEMENT; page numbering will be in numerical order.

MP MASTER
MA34076